

THE
LADY's PHILOSOPHY:
OR
SIR ISAAC NEWTON's
T H E O R Y
OF
LIGHT AND COLOURS,
AND HIS
PRINCIPLE OF ATTRACTION,
MADE FAMILIAR TO THE LADIES
IN SEVERAL ENTERTAINMENTS.

A N E W E D I T I O N.
TRANSLATED FROM THE
ORIGINAL ITALIAN OF SIGNOR ALGAROTTI.

— QUÆ LEGAT IPSA LYCORIS.
VIRG. ECL. X.

V O L. I.

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Библиография включает в себя все публикации, в которых упоминаются или обсуждаются произведения С. С. Соловьева. Включены также рецензии на эти произведения в периодических изданиях, а также критические статьи, рецензии и обзоры, напечатанные в альманахах, сборниках, антологиях, альбомах, а также в различных альманахах, сборниках, антологиях, альбомах, а также в различных

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Sir ISAAC NEWTON'S THEORY OF LIGHT and COLOURS, &c.

ENTERTAINMENT I.

The Introduction. A general Idea of Natural Philosophy. An Exposition of the most famous Hypotheses on the Nature of Light and Colours.

PLEASURE is the general Motive of our Actions: We search it in the Cabinets of the Curious; at Consorts of Musick, at Plays, and publick Entertainments; it leads us to Assemblies of Gaiety and Politeness. 'Tis my Inducement too, to give an Account of a Party to the Country, in which I had the Honour to make one last Summer with the

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Marchioness of _____. As I happened, during the whole Time of our Stay, to be very much at Leisure, free from the Noise and Perplexity of Business, the Calmness of so agreeable a Retreat presented me with a fair Opportunity of turning Author.

All Authors are fond of appearing in Print, howsoever they labour to persuade us to the contrary in their long-winded Prefaces ; and, for my Share, I confess, the flattering Insinuations of the same natural Desire encourage me to publish my Narrative : A Story meerly philosophical, made up entirely of some Conversations which I had with that charming Lady, upon the Subject of *Light* and *Colours*.

I am well aware, that Men of Gallantry will blame me for having made no better Use of my Time in a Lady's Company ; nay, 'tis what I have already reproached myself withal ; but I was obliged to conform to her Taste : And, in reality, considering the Influence so fine a Woman has over our Inclinations, I should not deserve Censure, though I had even carried my Obedience so far as to sit down and read over to her

Guic-



Guicciardini's* tedious History of the Wars of Pisa.

I own this Complaisance was a great Constraint, and I therefore took the Liberty to dispense with it, as often as *Light* and *Colours* would give me Leave. For how was it possible to attend to such a Subject, while the Marchioness display'd Charms, capable of inspiring Thoughts and Discourse little relative to Philosophy? We had, besides, the Advantage of the fairest Weather imaginable, an unclouded Sky, and a Retirement but too much calculated to feed that bewitching Disorder, which Beauty every where creates.

The delicious *Peninsula of Sirmione* (Birth-place of the gay *Catullus*) and those Mountains, whose Echoes used to repeat the elegant Lines of *Fracastorius*† (two remarkable

* A very tedious *Italian* Historian. It was a Saying of Dr. *Donne*'s, that if *Moses* had wrote like *Guicciardini*, the whole World would not have been big enough to contain the History of it's own Creation.

† *Jerom Fracastorius* was born of a noble Family at *Verona* in *Italy*, about the Year 1483. He studied Phyick till a few Years before his Death, when he devoted himself entirely to the Study of polite Learning, Mathematicks, Astronomy and Cosmography. He died of an Apoplexy in 1553, and was interred in the Church of *St. Euphemia* at *Verona*, where in

able Points, if I may use the Expression, in poetical Geography) formed the distant Prospect of our Palace, which stood on a pleasant Ascent. The clear Waters of the Lake *Benaco*,* whose vast Extent and roaring Waves emulate the Ocean, washed the Foot of our Hill. The Perfume of Orange and Lemon-trees on it's Banks, the refreshing Coolness of the Arbours, the gentle Murmur of Fountains, the moving Scene of proud Vessels sailing to and fro upon the crystal Lake, all these and a thousand other delightful Circumstances, would alternately have engaged all my Admiration, if it had been possible for any Object to withdraw my Thoughts from the lovely Goddess of the Retreat.

In her, the most sprightly Wit and sublime Imagination is tempered by the greatest Delicacy, and a surprising Strength of Judgment. Superior to the rest of her Sex, with-

1559 he had a Statue erected to him by Order of that City. His poetical Works are much admired, the Principal of which are his *Syphilis*; *Joseph*, an epic Poem, in two Books, but left unfinished at his Death; and his *Alcon, seu de Curâ Canum Venaticorum*.

* A Lake in the Territories of *Venice*, now called *Lagodi Garda*.

out being solicitous to appear so, she can, when Conversation takes that Turn, chat of Jewels, Lace and Fashions; and can also, when Occasion offers, propose the most abstracted Questions, and support the most grave and solid Conversations. She speaks without Study or Affectation; but you are won by the Sweetness and Ease of her Manner, and struck with that Life and Fire which shines in all she says. In short, though her Beauty engages many to solicit her Husband's Friendship, her Virtue guards her against being particular to any one of them. She has indeed collected in herself all the valuable Qualities, which we so seldom see joined together, except in the feigned Characters of Authors, who give a Loose to their Fancy: And hence it is, perhaps, that we are more apt to make our Addresses to Ladies on Account of their personal Attractions, than to pay the due Applause to their intrinsick Merit.

As soon as we were left alone, and the Hurry of Visits and Cards, at once the Relief and Plague of Society, was over, we dedicated Part of the Day to reading the best Books, as well modern as ancient,

contrary to the Opinion of that Monarch* who preferred old Books like old Friends. Poetry was our principal Entertainment; the rather, because all the Genealogists of the Arts agree, that the Country was the Place of her Nativity; but yet not so entirely for this Reason, as to exclude the Epic, Satire, Tragedy and Comedy, because they are peculiar to the City.

Our Conversations were heighten'd by a Spirit and Freedom of Criticism void of Pedantry. We observed the strictest Impartiality in our Remarks upon all Authors, whether *Italian* or *French*, ancient or modern; we admired the regular Conduct and Sublimity of the *Æneid*; the Perspicuity and Variety of the *Orlando Furioso*; the finished Design of the *Jerusalem*; that Air of Truth, those philosophical Allusions, and beautiful Passages, which occur throughout the *Henriad*; the inventive Genius display'd in the *Mandragora*†; the Humour in the *Misan-*

* *Alphonſus*, the 10th King of *Arragon*, ſirnamed the *Wife*, who used to say, he desired little more than four old Things, *viz.* old Wood to burn, old Wine to drink, old Books to read, and old Friends to live with. He began his Reign in 1252, and died in 1284.

† *Mandragora*, or *Mandragola*, an *Italian* Comedy, written by the famous *Nicholas Machiavel*.

thrope; Sannazarius's* Softness, and the happy Negligence of Chapelle.

We took Care that neither Illusion nor Prejudice should bias our Judgment: We were not such Zealots for Antiquity, as to fancy Harmony in a Poem, meerly because it was old; nor yet so national, as to pass by the noble or delicate Thoughts of an Author, only because he was of a different Country. I threw in, from Time to Time, little Digressions to vary the Conversation, which the Marchioness seemed to relish as much as any Compliments I could have made her upon her Charms.

On my mentioning to her, in one of these Digressions, the Beauty and Energy of

* *Actius Sincerus Sannazarius* was born at *Naples* of a noble Family in 1488. He was Secretary to *Ferdinand King of Naples*, who honoured him with a great Share of his Confidence and Esteem. He was eminent for his *Italian* and *Latin* Verses; he spent 20 Years in correcting and polishing his Poem *De Portu Virginis*; but his Piscatory Eclogues in *Latin*, which he wrote when he was young, were preferred to all his other poetical Writings. He was rewarded by the *Venetians*, with a Present of 600 Crowns for his celebrated Epigram,

Viderat Hadriacis Venetam, &c.

He died in 1530 of Grief, because the Prince of *Orange*, who was General of the Imperial Army, had demolished a Tower belonging to his Country-house. He lies interred near *Virgil's Tomb*.

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English Poetry, she expressed a great Desire to be made acquainted with it; not doubt-ing, she said, that that illustrious People were as much the Favourites of *Apollo*, as the Votaries of *Minerva*.

As it was my Study to gratify in every thing the Curiosity of this worthy Lady, from whom I received every Day new Ci-vilities, it was no small Trouble to me, that I was able to give her but an imperfect No-tion of *Dryden's* universal Genius and har-monious Numbers; of *Waller's* agreeable Softness; of *Prior's* easy and various Stile; of the lively and keen Wit of *Rochester* and *Dorset*; of the correct Majesty of *Addison*; of *Shakespear's* daring Flights; and of that gigantick Sublime, wherewith the great *Mil-ton* ennobled his Works.

To talk of the Merit of a Poet, is like endeavouring to describe the Beauty of a Face; to be a competent Judge, you must examine each with your own Eyes. If you quote here and there a Line of an Author, even in the original Language, 'tis as if you shewed separately, a Nose, a Mouth, a Cheek, or a Complexion: No; we ought to see the Whole together, and observe the Out-line, the Shadowings, the Proportions, and

and the Symmetry, whence results that complete Charm, which sinks into the Heart, and which no Tongue is able to express.

However it gave me some Consolation, that amongst the Papers which I had brought with me into the Country, there luckily happened to be Mr. Pope's Ode to Musick on St. Cecilia's Day. This great Poet's Name is no where unknown, except among those who are likewise ignorant, that there is any such thing as Poetry in the *English* Language.

I took this Ode along with me next Morning into the Arbour appointed for our poetical Conferences, our little *Parnassus*, where we reviewed the Poets of all Nations. Here, having in my Heart asked Pardon of the *English* Muses, I began to read Mr. Pope's Work, and translated it to the best of my Power. The Marchioness listen'd to me with an Attention, that the Fair do not always think themselves obliged to pay; but she could not forbear interrupting me, when I came to this Part—

While in more lengthen'd Notes and
flow

The deep, majestick, solemn Organs blow;

Hark! the Numbers soft and clear
Gently steal upon the Ear ;
Now louder, and yet louder rise,
And fill, with spreading Sounds, the
Skies ;
Exulting in Triumph, now swell the bold
Notes,
In broken Air, trembling, the wild Mu-
sick floats,
Till by Degrees, remote and small,
The Strains decay,
And melt away,
In a dying, dying Fall.

She was lost in Admiration of this Choice of Epithets, which so perfectly described the Instrument, that she was almost persuaded she heard it play. I cannot pretend to say, continued she, whether you be affected by these Lines in the same Manner that I am ; but I verily believe you are, and I judge so, by a certain Sensation of Pleasure, which your Countenance betrays unknown to you.

Madam, you have a Faculty, replied I, of penetrating into the most minute and secret Movements of my Heart, except those you yourself influence, and how can they deceive you ? Your Taste too is no less exquisite

quisite than your Penetration ; there is a wonderful Delicacy in your Apprehension of those speaking Images, which Poetry so much delights in : These Sorts of Epithets are Touches of the Pencil that give Life to a Picture, of which the white Hand, the open Forehead, and the languishing Eye, are but Sketches.

These are the Master-strokes, no doubt, said the Marchioness ; but pray what am I to understand by the *Seven-fold Light* an Expression which I lately met with, in a Song, addressed to the philosophick* Lady of *Bologna* ? Is it not a Kind of Hieroglyphick ? 'Tis at least to me, and to many others whom I have, in vain, desired to explain it. You mean, Madam, these Lines---

That *Seven-fold Light*, that golden
Ray,
Shot forth from the bright Orb of
Day,
In whose direct transparent Line,
United, all the Colours shine ;

* *Laura Maria Katherina Barfi*, a learned Lady in *Italy*, who, in 1732, at 19 Years old, held a philosophical Disputation at *Bologna*, upon which she was admitted to the Degree of Doctor in that University.

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Whose Beam, as thro' the Universe it
burns,
All Objects shews, and while it shews,
adorns.

If you understood the whole Force of that Expression, you might see in it a Kind of *Newtonian Painting*, perhaps, indeed, too philosophical for Poetry, but at the same time full of Truth, and without the least Hieroglyphick Obscurity.

What ! cry'd the Marchioness with Surprise, it seems you are acquainted with this Passage ! Is this also written by an *English Poet* ?

I was in Hopes, Madam, that these Verses, written by an *Italian*, who has the Honour to converse with you every Day, and must consequently have an infinite Esteem for you, might have met with, at least, as favourable a Reception, as the Lines of a Stranger, who has the Misfortune to be Native of a Country so distant from you.

Oh ! now I understand you, return'd she, and if it be true, that no-body can so well explain the Meaning of an Author, as the Author himself, you are, I find, the properest Person to give me a Comment on

this

this Piece. Come along then, good Mr. Author, deliver me from the Perplexity into which your *Seven-fold Light* and *Newtonian Painting* (as you call it) have thrown me. What cramp Words are here ! enough to make one believe, that in praising one Lady, you were determined no other of the Sex should understand you.

A respectful Attention and sincere Regard for you, Madam, are doubtless the Marks by which you found me out, and by them you may always know me.—But finding at last that she would not be at Rest, unless I explained to her *Newton's Opticks*, towards which she had never made the least Essay, and judging what time this would take up, and that it could not be done in a few Words ; were it not better, continued I, to stop short here, and follow the Rules of the Stage, where the Play is at an End as soon as the Personages have discovered one another ? And besides, Why do we quit Mr. *Pope* ? Believe me, Madam, you will be more delighted by the bare reading of his Poem, than by the most judicious Explanation of mine.

No, no, said she hastily, that we may read another, but for to Day, let us, if you please,

please, go in direct Opposition to the dramatick Rules, and keep the Characters a little longer upon the Scene, but still with an Eye to the Catastrophe, or in other Words to my Information.

At length she prevailed upon me, to attempt giving her some Notion of that *Theory* to which I had alluded in my Verses; and (as I suspected that for this one time of her Life, she might have fallen into the Humour of a Number of Ladies, who pique themselves upon saying, that they thoroughly understand Matters, of whose very Elements they have not the least Idea) I began in a most Laconick Way to tell her, that, by Means of *Newton's* Discoveries, and pursuant to natural Truth, we are taught, That every Ray of Light is composed of a Multitude of smaller Rays, whereof some are *Red*, some are *Orange-colour'd*, some *Yellow*, some *Green*, others *Azure*, others *Indigo*, and others again *Violet*. That from these seven Colours, blended together (as they really are in a Ray darted from the Sun) there arises one *white*, or rather *yellowish* Colour, which is the Colour of Light. That if this direct Ray be refracted by a certain Piece of Crystal, called a Prism, then all the

the smaller Rays, of which it is composed, being of different Colours, and consequently of different Degrees of Refrangibility— Hold, hold, dear Sir, said the Marchioness, disappointing me; why this is a Comment with a Witness! This requires Explanation more than the Text it should illustrate. No doubt 'tis owing to my Want of Comprehension; but I must own, this whole Business of Refraction and Rays diversly refrangible quite amazes me, and confounds all the Ideas I had begun to form. To me 'tis all impenetrable Darkness; give me some Light, I beseech you, and contrive, if possible, that I may have less Cause to complain either of your Obscurity, or my Dulness.

Lord! Madam, you will not be satisfied, answered I, unless I make you a Comment as long as that of the *Malmantile*, a Piece which seems to be written, as I observed to you the other Day, in the true Spirit and Humour of *Mathanafius** himself, that *Moliere* of the Scholiaſts.

* Monsieur de St. Hyacinthe, under the fictitious Name of Dr. *Mathanafius*, published a Piece intitled, *Chef d'Oeuvre d'un Inconnu avec des Remarques*, in order to ridicule the Impertinence of some Critics and Commentators. The *Malmantile* is an *Italian* Piece wrote after the Manner of this Author.

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At least, replied she, *Newton* is like to make a better Figure in your Explanation, than *Micheli* does in that Comment, where his Discoveries are of no Manner of Service towards the Illustration of the Poem — But, however that be, you seem to speak with such an Air of Certainty, and so seriously join together *Newton's* Discoveries and the Truths of Nature, that I am impatient to become a *Newtonian* too.

Ah! Madam, you have now hit upon the true Way of propagating Sir *Isaac's* *Theory*, and bringing it into Fashion. *Pemberton*, *Gravesend*, *Dunch*, and the rest of the Advocates for this new Doctrine, may safely entrust to you it's Interests and Reputation. But, once again, what will Mr. *Pope* say (shewing her the Book, which I held still in my Hand) if you leave him thus, in the Beginning of such a fine Ode, for a sudden Fancy, which you have taken, I know not why, to *Light* and *Colours*?

Oh! Sir, he need not be jealous, returned she: Nothing should interrupt the Pleasure I take in hearing him, but my Attention to an illustrious Philosopher, a *Newton*, whose Honour, as his Countryman's, he ought rather to take a Pride in promoting.

True

True — But, Madam, rejoin'd I laughing, you forget that Poets are a Race of Men who fancy themselves sacred, and no sooner does the Divine Enthusiasm seize them, than all Considerations of Country, nay of Family, are laid aside. A Poet, Madam, looks upon himself as a Character superior to any Philosopher, let his Merit in Discoveries be ever so great ; ay, though he had found out what the Union between Soul and Body consists in. — Well, well, pursued she, no Matter for their private Opinions ; but, I am sure, there appears none of this Arrogance in their Writings.

It was to no Purpose that I pleaded my Incapacity, and offered all the little Excuses which are usually made on the like Occasions : The Marchioness insisted on seeing my *Newtonian* Picture, as she called it. I beg'd she would at least have Patience 'till the Evening, alledging, that for some Years past the Night had been peculiarly set apart for learned Speculations, and quoting a parallel Case of a fair Lady, who took her Lessons from the most polite Philosopher that *France* ever produced, in an Eglantine Bower, many Hours after Sun-set.

There

There was Reason for that, replied she ; but I believe you will scarcely infer from thence, that the Night is so proper a Time for an Enquiry into the Nature of *Light* and *Colours*, as the Day : And, added she, with a sort of Authority that sweetened the Command, and made Obedience a Plea-
sure —

This Day, rebellious, nay this Hour
Shall you confess my sovereign Pow'r.
Proceed — The glorious *Light* your
Theme —

'Till the fond Echo of each Stream,
Each Hill, each Grot of this Retreat,
The pleasing wondrous Sounds repeat.

Thus was I absolutely obliged to begin ; but how to do it was the Difficulty : For, as the Marchioness was utterly unacquainted with natural Philosophy, I found it necessary to give her some general Idea of it, before I proceeded to explain *Newton's Theory*. At last, after having again in vain reminded her of Mr. *Pope*, and proposed some other Subjects that required less Application, and might afford greater Amusement, we returned into the House to avoid the Sun's intense

intense Heat, where I resumed the Discourse in the following Manner.

When once Society was so far established, as not to need the Labour of all it's Members (and this I look upon as it's first Step towards Perfection) it is not improbable, that those Men, whose Circumstances could afford them Leisure, either excited by a natural Desire of Knowledge, or willing to avoid the Imputation of Laziness, began to turn their Enquiries upon such Things as compose the Universe, their various Relations, Differences, and Effects.

These speculative People soon assumed the Title of Philosophers: As Light is in itself the principal Ornament and the Means whereby we enjoy the whole Scene of Nature, it became, in all Likelihood, one of the first Objects of their Speculation; and in their Observations upon the Nature of *Light*, the *Colours* also, with which it beautifies and distinguishes Objects, must necessarily have occurred.

Hence, I am apt to believe, that *Optics*, or the Science of *Light* and *Colours*, is a Daughter of Leisure, as well as all natural Philosophy in general: Later, each of them in their Origin, than a kind of natural Religion,

ligion, or a social System of *Morals*, and some *Geometry*, which were absolutely necessary to Mankind almost from the Beginning; contemporary to *Poetry* in it's Dawn, but earlier than *Metaphysics*, which required still greater Leisure and Contemplation.

I am glad to hear, said the Marchioness, that *Poetry* and *Natural Philosophy* have the same *Æra*: The Transition which you made, in Complaisance to me, from one to the other, will, perhaps, appear the less abrupt — Madam, replied I, that Transition which Philosophers made (from a slight Smattering in a few Things, to their undertaking so presumptuously to explain all Nature, and forejudge her Effects) was infinitely more strange and sudden: This they called inventing of Systems; which is just as if a Fellow, upon the Strength of having one or twice spoken to an able Minister of State (about the Weather, it may be, or some such indifferent Subject) should fancy himself qualified to write his Character, and imagine he had penetrated his most profound Secrets.

They should rather have endeavoured, by frequent Observations and Experiments, to get acquainted with the Effects of Things, before

before they attempted to form Systems about their Causes. They were to act, if possible, like those two ancient Philosophers, one of whom retired into the Country, to consider, with more Tranquillity, the Nature of Bees; and the other spent threescore Years in a Course of Observations upon them, that they might be able to write of the Qualities of that admirable Insect.

But herein lies the Misfortune: Experiments and Observations require a great deal of Time, much Pains, and unwearyed Application; (not but that some of the most useful and curious have been struck out by meer Chance;) or, on the other Side, Mankind is generally in too great a Hurry to become knowing, or, at least, to appear so to the World.

Besides all this, the Revolutions of Empires, the Barbarity of Nations, their Occupations, Genius, and Characters, have not a little contributed to retard the Progress of *Philosophy* in those early Ages.

She fixed her Abode for a long Time amongst the *Indians*. The Priests transmitted her Precepts to their Successors, with great Care and Exactness; nor were they more jealous to keep their Blood pure, than

to

to preserve their Tradition secret. After that she lay concealed for many Centuries, under mystical Hieroglyphicks, in the Temples of *Egypt*. Thence she passed over to the Porticos and Groves of *Greece*, where *Allegory*, *Fable*, and the Flowers of *Rhetorick* so disguised her, that her natural Beauty was quite lost in an Heap of superfluous Embellishments.

Greece was not a Country where *Philosophy* could long maintain her Ground: Imagination, the Characteristick of it's Inhabitants, opposed her Settlement. She was, at one Time, in Danger of being utterly expelled by a certain Man (remarkable for a grave pleasantry, and irresistible Persuasion) whom the Oracle dignified with the Title of the *Wiseſt among Mortals*. He held, that we ought not to busy ourselves with Things above us, and reduced our Curiosity and Enquiries to the Knowledge of ourselves. He excluded from our Search all the other Mysteries of Nature; and instead of allowing us to pry into the grand Combinations of the Universe, limited us to Observations upon the little Chaos of human Extravagances; and reclaimed us from that Rapture, with which we are transported by the Contem-

Contemplation of vast and remote Objects, to the melancholy Reflection upon our own Misery. Herein, more cruel than *Pandora*, when she shewed Mankind the fatal Contents of her Box, he did not point out the least Gleam of Hope to escape. He was, notwithstanding this, held in the highest Veneration as the Father of a new Kind of Philosophy, called *Morality*; a Science, which though it has been the most copiously discussed of all, yet is still in reality the least understood.

At length, by slow Advances, *Philosophy* arrived at *Rome*, much about the Time when Voluptuousness, Effeminacy, and Corruption first poured in from the East. Here she had but little Prospect of prevailing upon a People, whom she found more inured to the Toils of War, than inclined to cultivate Arts and Sciences: A People who sought no further Knowledge, than how to spread the Terror of their Arms, and the Reputation of their Clemency.

The primitive Christians received great Assistance from her, in their Disputes with the *Pagans*, whose Defeat was scarce achieved, when she raised such Dissentions amongst the very Men whom she had so sup-

ported in dethroning *Jupiter*, and overturning *Olympus*, that the Vessel of the Church had well nigh perished at it's first sailing out of Harbour.

This Heat and Animosity of jarring Opinions, this idle War of Words, was not yet composed, when that bloody War, which the *Barbarians* waged against *Rome* and Learning, broke out in it's full Fury. That great Empire was overthrown, and Literature, sunk under Oppression, remained buried in profound Obscurity; 'till at last, some Sparks of ancient Science were re-kindled in *Arabia*.

Aristotle's Doctrine was then revived in the East, which the Monks found so consistent with their Manner of Life, that they embraced it readily — What Pains and Study does it not require to form a right System of Philosophy! How many great Geniusess must concur! This you may frame some Idea of, Madam, if you please to reflect, what a prodigious Number of Artists must jointly labour, at one Piece only, of those rich Stuffs, whereof you fine Ladies make your Apparel — But a System, in which the Authority of *Aristotle's* Name was admitted

admitted for Reason, could not disturb the sanctified Indolence of the Cloister.

Though this Philosopher* had formerly been expelled *Athens* by the Priests, he met with a more favourable Reception amongst our Clergy. His Fortune, however, was not without it's Reverses. Sometimes he was looked upon as the Propagator of pernicious† Tenets, and at other Times considered

* *Aristotle* retired from *Athens* in order to avoid a Process of Irreligion, which the *Athenian* Priests carried on against him: Some assert that he was charged with Impiety, on Account of a Hymn which he had made in Honour of his Friend *Hermius*. This Hymn is still extant, but there is not the least Impiety to be discovered in it; but his Accusers urged that he had profaned Divine Songs, by prostituting them to the Honour of a mortal Man. *Aristotle* retired privately to *Chalcis*, where he pleaded his Cause, at a Distance, by Writing, which was the safest Way he could take; for his Accusers were a Set of Men who would never have let him been at Rest. Some Authors report that this Philosopher drowned himself in the *Euripus*, a narrow Sea near *Eubaea*, because he could not find out the Reason of it's Ebbing and Flowing seven times in one Day. But the more received Opinion is, that his very great Application in the Study of this Phænomenon brought an Illness upon him, which occasioned his Death.

† The Physics and Metaphysics of *Aristotle* were burnt by Order of a Council held at *Paris* in 1209, and the reading of them prohibited under Pain of Excommunication. This Prohibition was confirmed in 1215, but *Aristotle*'s Logic was allowed to be taught. This Prohibition was renewed in 1231, by *Gregory* the

dered as a Man fraught with Knowledge above the Reach of human Understanding. Religion and Philosophy, at that Period, had formed a stricter Alliance than ever, which must necessarily produce Confusion in the one, and Ignorance in the other; because the Spirit of Religion and Philosophy is as different in their Characters as in their Ends.

From thenceforward Philosophy dwindled into a meer Chaos of insignificant Questions; a Concatenation of unintelligible Definitions; a blind Rage of Disputation; and a more blind Devotion for *Aristotle*: He was called, by way of Excellence, *The Philosopher*, or a *Second Nature*. There burst in, like a Deluge, upon the Schools, an harsh, crabbed Jargon of senseless, indefinite Terms, full of Obscurity, and even hard to pronounce, which arrogantly assumed, for many Ages together, the pompous Name of Science.

And, as in *China*, that Man is esteemed the best Scholar, who has the largest Cata-

the VII, but with this Addition, that he only forbid the Reading *Aristotle's* Works till they should be corrected; again, in 1261, they were prohibited: But in the Reformation of the University of *Paris* in 1366, this Philosopher's Physics, as well as his other Works, were allowed to be read.

logue

logue of Words by Rote, and can scribble over the greatest Variety of Characters; so, amongst these Coxcombs, he became the highest in Repute for Learning, who, decked in the Pageantry of a Doctor's Robe, using certain Gestures in certain Places, could sputter out, with the most fluent Volubility, this ænigmatical pedantick Gibberish. Whoever had been at the Pains to turn over their Common-place Book, might as easily have known before-hand what their Answers and Distinctions would be, as one can tell what Passage of a Tune is to follow in the Scraping of a common Fidler; or what Rhymes are to come next in the Verses of a *Grubstreet* Poet.

Such was the Cloak, with which this conceited Herd covered from the Eyes of the People that Ignorance, which very often they could not hide from themselves. The Pride of the Schools was supported by the Noise of empty Words, and the Tyranny of Names; for it was universally believed that they really contended for Truth; whereas, poor bearded Infants! their whole Time was consumed in bandying to and fro the Bubbles they had blown.

The Schools were so long possessed with this Veneration, this obstinate Fondness for the Ancients, that *Natural Philosophy* made but small Progress 'till the last Century; about which Time there started up some Men of Sense, who were destined to be the Martyrs of Reason. Particularly one *Galileo** of *Tuscany*, who had the Courage not only to assert, but evidently to demonstrate, that Professors, who had sat threescore Years in the Doctor's Chair, had only been labouring

* *Galileo* was born at *Florence* in 1564. He was put into the Inquisition for maintaining the diurnal Motion of the Earth, and asserting the Sun and not the Earth to be the Center of the World. These Propositions were condemned by the Inquisition as false and heretical. He was not discharged till he had promised to renounce his Opinions, and not to defend them either by Word or Writing, or insinuate them into the Mind of any Person. Upon his publishing his Dialogues upon the two chief Systems of the World, the *Copernican* and *Ptolemaic*, in 1632, he was again cited before the Holy Office. The same Year the Congregation convened, and in his Presence pronounced Sentence against him and his Book, committing him to the Prison of the Holy Office during Pleasure, and commanding him, as a saving Penance, for three Years to come and repeat once a Week, the *seven Penitential Psalms*, but reserving to themselves the Power of moderating, changing, and taking away altogether, or in Part, the above-mentioned Punishment and Penance. He was discharged from his Confinement in 1634, but the Impression of his Dialogues of the System of the World was burnt at *Rome*.

all that while, by intense Study, to grow gray in Ignorance.

He paid dearly for his Rashness. Who-soever, in such dark Times, presumed to take the *Light of Reason* for his Guide, did, in a Manner, reproach others for their Abuse of it. For it was as much prohibited in those Days, properly to expound the Sciences, as in *Old Rome* to remove the Boundaries of the consecrated Field, adjacent to the Walls of the City.

Galileo, in spite of the Storms that threatened him, cleared for them the Way which they should have taken at first: He explored Nature, and opened the right Path to Experiments and Observations, by reducing himself to that laudable State of Ignorance, which, when backed by Curiosity, leads us on to Discoveries, and enables us to arrive at Knowledge in the End.

Galileo might be truly called the *Czar of Philosophy*. That People, amongst whom *Peter the Great* introduced Arts and Sciences, differed very little in Character from those whom *Galileo* attempted to reform. No Nation in the World ever took more Pains to make a Proficiency in Literature, than the *Russians* did to continue in a most scan-

dalous Ignorance: They enacted Laws, prohibiting all Strangers to come into their Country, and all Natives to stir out of it: Infatuated and blind to their own Interests, they opposed all Innovations whatsoever!

The antique Schoolmen were exactly of the same Disposition. Puffed up with an unmerited Reputation, they held in utter Contempt all Experiments, nay all Demonstrations, and went on, indulging themselves in the Enjoyment of their old Errors, rather than they would admit any Reformation in their System. But (as Force and Authority have commonly greater Influence over the Vulgar than Reason) the *Czar's* Project was much sooner brought to bear than the *Tuscan* Philosopher's: He was opposed and thwarted by another Sect, which was the more formidable, as it had begun to shake off the Yoke of Prejudice; as its Members took Care to advance none but clear and distinct Ideas, and wrote in a precise and methodical Manner. Qualities as rare in those Days, as they are at all Times, pleasing and necessary.

These Moderns undertook moreover, by Means of certain Movements and Figures, which they supposed in the Mechanism of Bodies,

Bodies, to account for the most abstruse and difficult Things. These fine Promises (seemingly confirmed by a charming Air of Simplicity diffused throughout their Writings, as in a well-designed Romance) you may well imagine, Madam, could not fail to engage all Opinions, and form a powerful triumphant Sect: For their Doctrines contributed to flatter and indulge that Self-love so natural to Mankind, which had been humbled and mortified by *Galileo's* Observations.

Their Principles of Consequence met with universal Applause. The Moderns had their Partizans as zealous and obstinate, every whit, as those of the Ancients. The Prejudices of the old Schools became continual Objects of Ridicule to these, who were unguardedly falling into the same Absurdity. But (as the most fatal Stroke of all to these philosophical Romances) there were published, from Time to Time, new Experiments which they had never known, nor were at all aware of, but which debased them considerably. Then these glaring Systems, which had cost so much Time, Toil, and Contemplation to raise, were at once most piteously overthrown.

Farewel, a long Farewel to all their
Glory !

The sad Recital of their wretched Fall
Might melt the Hearts of Enemies to Pity.
Ev'n *Oxford's* rigid Sons (howe'er averse
To the delusive Pedantry of Systems)
Would heave the Breast, and wipe the
falling Tear.

The only Expedient then that I can think of, replied the Marchioness, to banish such melancholy Reflections, and to rescue poor degraded Systems from the Shame and Insults that saucy Experiments throw upon them, is, that Philosophers for the future, before they set about forming their Systems, shall first make the most accurate Observations on all that Variety of wonderful Objects, which compose this great Frame of the Universe.

Undoubtedly, Madam ; and this is the very thing that *Newton's* Disciples so strenuously insist upon—— There must certainly be some secret Intelligence between you and them, that you are so well acquainted with their Sentiments—— Suppose a Mechanick were to see the famous Clock at *Straßbourg* ;

were

were it not ridiculous in him if he should pretend to explain it's inward Structure and Movements, before he had thoroughly examined it's outward Machinery, it's extraordinary Manner of striking the Hours, and those other surprizing Operations, which so justly entitle it to a Place amongst the most exquisite Master-pieces of Art?

In like Manner, the *Newtonians* maintain, that there can be no System formed, fit to abide the Test of Time and Criticism, without careful Observations and nice Experiments made on the several Phænomena of Nature; nor is there any other true Method whereby we can attain to the least Certainty of Knowledge in those Laws, which she so invariably observes throughout her whole Progress.

Des Cartes, for Instance, who was the chief Author of this enterprising Sect, how was it possible for him to form any rational System of *Light* and *Colours*, ignorant as he was, of their principal Properties? and which would have been still a Secret, had not *Newton* published his Discoveries. Was not this attempting to carve a Statue without the Marble?

On the contrary, the best Philosophers, in those learned Societies founded and maintained by the Liberality of Princes, or the Genius of Nations, proceed in a very different Method. They are busied in making Observations, and preparing Materials for Posterity to build Systems more solid and successful than the preceding ones. These Men do not, indeed, make such pompous Professions, as those who pretend to create (if I may so call it) a World, in the Twinkling of an Eye; but, in Return, they perform all they promise, and such Punctuality, let me tell you, is no less engaging in a Philosopher than in a Mistress.

I must own, for my Part, said the Marchioness, I have thus much of the Woman in me, that I admire and respect Men who undertake great and difficult Enterprises. Is it not merely on this Account that we so deeply interest ourselves in the Adventures of Heroes? There is a noble Air of Superiority in the daring Genius of these philosophic Worthies, which gives me vast Pleasure: And if they do not always keep strictly to their Word, we should make Allowances for human Weakness. And then, if we are to wait, continued she, for a perfect

Know-

Knowledge of Nature's Phænomena, when can we have those complete Systems you speak of? I am afraid they will be as rare in our Times, as the Secular Games among the *Romans*; nor must I flatter myself with the Hopes of living to see a single one of the Kind. So that I think we had e'en better be content with those we have, imperfect as they are.

You have, to say Truth, Madam, returned I, produced the prettiest Arguments imaginable to recommend Trifles: I should serve you right, if I desired you to prove them. But I will have more Consideration for you, than you are pleased to shew for me; you, whose severe Commands oblige me to play the tiresom Part of a Philosopher, at a time when I might otherwise have turned your charming Conversation to so sweet Account.

I shall not then be so hard upon you (howsoever your little Reasons authorise me) as to enter upon a serious Enquiry, whether Light be a Substance, or an Accident; or the Act of somewhat Transparent, as far forth as Transparent: Whether Colour be the first Figuration of Matter, or a certain Subtile

Flame which bodies emit, the Particles of which are proportioned to our Sight.

Do but observe what Deference I have for you, and what Vexation I spare you. Might I not again, with great Gravity, propose the Question, whether Light, or rather it's Spirit, be not the Soul of Nature? That Soul, which, according to *Plato*, is placed between Nature and Ideas, to unite the sensible with the intelligible World; and whether this be not the Reason why the *Platonists* represented the Element of Fire, the Seat of Light, under the Figure of a Pyramid, resembling that mysterious Triangle which they used as the Symbol of that universal Soul? Vain, empty Riddles, to disguise the learned Ignorance of Antiquity!

And, perhaps, if you had fallen into any other Hands, you might have been set a yawning with some *Gothic* Passage from *Dante*; nay, you might possibly not have escaped without a Touch on Divinity, or, at least, an Explanation of the mystic Sense hid under the Fable of *Prometheus*, who stole a Ray of the Sun to animate his Statue.

I find, replied the Marchioness, one cannot be too cautious in conversing with Philosophers, if they thus take Advantage of

every

every Word one says. But you, Sir, behave like those Tyrants, who reckon they confer a Favour, where they happen not to do an Injury. However I must acknowledge myself much obliged to you for not plaguing me with all this fine Stuff, of which I freely own that I do not understand a single Syllable.

Well! Let us see, answered I, how much better you will understand the Doctrines of those more sensible and less crabbed Ancients, who strove to account for every thing by a *Vacuum*, and by the Motion and Figure of certain very minute Bodies, which they called *Atoms*; whence their Sect got the Name of *Atomists*. This Sect is, perhaps, the oldest of all. It attempted, in this last Age, to oppose *Des Cartes*, and to raise it's self, by the Power of Eloquence, on the Ruins of *Aristotle's* School. These *Atomists*, for Example, asserted, that Light is nothing else but a vast continual Torrent of the smallest Kind of Particles or Atoms, which, pouring with great Rapidity from the Body of the Sun, fills all the vast aërial Tract. So that, by their Hypotheses, *Light* is still followed by new *Light*, and one Ray impels another, as you may well comprehend

hend by the Comparison of a Fountain—
Oh! I comprehend it very well without
your Fountain, interrupted she; but as to
these Philosophers, who thus waste the Sun
by such a perpetual Flux of his Particles, I
begin to fear they may, some time or other,
leave us in the Dark at Noon-day.

That indeed, answered I, were but a
scurvy Trick, though some Ladies might
find their Account in it, as they could then
be seen only by Candle-light; but you,
Madam, would be a considerable Loser.
However, don't be in a Fright—Such
Revolutions take up more time than the
Overturning an Empire; and besides, the
Atomists give us such Assurances of Safety,
that it were a Shame to confess any Fears.

For, in the first Place, they will make
you the Sun of a Substance as compact as
you please. Secondly, they will assure you,
that the Particles proceeding from him, are
so inconceiveably minute and subtile, that
the Loss of them can cause but a very
trifling Diminution in his Orb, even after
a thousand Centuries. And still more to
calm your Fears, they will prove this
Doctrine to you, by the Example of a little
Morsel of Colour, which is found sufficient

to

to tinge a great Body of Water. Instances, deduced from odoriferous Bodies, will shew you how astonishingly small the Particles of Matter are: A Grain of Musk emits incessantly Millions of Atoms, yielding a Perfume strong enough to intoxicate, as 'tis said, at a certain Distance, and stupify Serpents of an enormous Size; and yet we find, that after a considerable Time, it has scarcely lost any thing of it's Weight. You see likewise how long Amber-grease will retain it's Smell. From all which, you may judge how extremely subtile the Particles of Light must be, which can pass through the most dense Bodies, such as Diamond and Gold-leaf.

All this is very fine, Sir; but I cannot help being still anxious about that prodigious Emanation of luminous Particles, which the Sun, without Intermision, sends forth; and that too, in a Quantity sufficient to fill and enlighten the whole Universe. I don't find myself at all encouraged by your Musk, your Diamond, or Amber-grease.

Pray, Madam, have not you some little Disposition, replied I, to that learned Melancholy, which possesses the Virtuosi of the flying Island? an Island lately discovered by

Doctor

Doctor *Swift*, who, under Poetical Allegories, has given us a most delicate philosophical Satire on human Nature.

As this Island (which, in the Language of it's People, is called *Laputa*) is different from all others hitherto discovered by our Travellers, so it is inhabited by a very singular Species of Men: A Set of abstracted gloomy Philosophers, always buried in profound Contemplation, and so entirely given up to Spleen and the *Mathematicks*, that they must have a Flapper continually near them, who by gently striking them, from Time to Time, with a little Bladder, rouses and recalls them to the Busines of this sub-lunary World. Their deep Learning and Knowledge fills them with perpetual Frights and Apprehensions, while the Populace enjoy an uninterrupted Calm, under the Shelter of an happy Ignorance.

Sometimes they are alarmed at the Danger of a Comet's brushing too near the Earth, and reducing it, in an Instant, to Ashes; at others, they are afraid that the Sun will, one Day, swallow us up: Then again, their Terror suggests, that possibly that great Source of Light and Heat may at length be exhausted, and the World left envelopped

envelopped in perpetual Darkness. And now, Madam, might I not well say, that your Fears had some Tincture of the *La-putan* School?

As to the Flapper, said she smiling, I could do well enough without him, especially in your Company. But, pray do you think, that so dreadful a Menace, as that of eternal Darkness, may not reasonably inspire some Apprehensions? And are you not rather obliged to me, that I take so great an Interest in the Fate of your heroine *Light*? Nay, it is a Shame for you not to shew the same Concern for her, that I do.

You will find, Madam, replied I, that these *Atomists* have been careful of your Repose, and have studied to preserve what you express such Regard for. They have a Way of recruiting the Sun; and this they will do, with that Ease and Dexterity, which a Philosopher should be Master of, who makes all Nature subservient to his Schemes. They will make the Seeds of Light and Heat, which are dispersed throughout the Universe, return continually into the Sun, to repair his Losses. They will also place something round him, by which he is to be sustained and restored, as a

Lamp

Lamp is fed by Oil, or other unctuous Matter. Besides, there are Systems which will help us out, with the Loan of a Comet now and then, to throw in to him; and if this be not sufficient, I can recommend you to some Philosopher, who will, perhaps, contrive to drop in a Star likewise. But, if you can't depend upon human Systems, we may have Recourse to that Cœlestial one, which an Angel revealed to *Adam*, in *Milton*, who assures us that the Sun is supplied with Aliment by humid Exhalations, and that he goes down regularly, to pass his Evenings with the Ocean. And now, Madam, what would you more?

Who, I, Sir? said she, nothing, I assure you. There needs not half this to restore the Courage of a *Laputan* himself. But, for the present, I am in Hopes we shall not be obliged to trouble any of the Philosophers, and much less any of the superior Beings.

I wish, with all my Heart, Madam, replied I, that you may never feel more material Fears, than *Philosophy* throws you into; and that your Beauty, which is like the Sun in so many other Circumstances, may resemble him also in it's Duration. I am rejoiced

joiced to find, that if the Opinion, which I advanced, did at first occasion you some Apprehensions, it has at last intirely dispelled them. You are so subject to be alarmed at every Trifle, that I can't tell what might have been the Consequence, if I had mentioned to you that Hypothesis of a famous Man amongst the Ancients, who asserted, that the Sun is a Mirrour, formed of a Substance resembling the most polished Crystal, so as to reflect to us the Particles of Light, which crowd to it from all Parts of the Universe, and are united in it's Sphere. Where should we find Materials above to repolish this Glass when it came to be fullied?

Let the Blockhead, answered the Marchioness, who took it into his Head to make the Sun of Glass, think of Means to clean it when it grows dim: For my Part, I chuse to suppose it the Soul of the World, and the great Source of Light.

Be pleased to add of Colours also, Madam, since, without Light, they instantly vanish, and are no more — No more visible, you mean, Sir, rejoined she; What! would you fain persuade me, that after Night-fall, there are no longer any Colours in this Picture? I wonder you don't affirm, that

the

the Picture likewise vanishes, for the same admirable Reason, that it is longer seen.

The Picture, Madam, and the Canvas remain, and upon it, certain Dispositions in the Figure and Texture of those Atoms, whereof the Chalks, used in Painting, are composed. These Dispositions, at the Return of Light, will again adorn the Canvas with the Colours, the Half-tints, the Lights and Shades, will restore to the Eyes of a Portrait their piercing Rays, or their humid Languish ; will distinguish the retiring Colonnade, the verdant Meadow, or the opening Blush of the Morn. In the Dark, these Things do not exist, because they are only the Result of Light, acting upon that Disposition of Atoms.

To confirm this, I might quote the Authority of *Virgil*, who says expressly, that the Shades of Night despoils all Objects of their Colours : The philosophical Poet *Lucretius*, who has comprised the whole System of Atoms in most elegant Verse, shews us what dreadful Consequences would ensue, upon our supposing that Colour is inherent to Bodies, or their Principles — Seeds (says he) are colourless, without a Dye,

For,

For, either this cannot to Seeds agree,
Or, Seeds are not immortal all, and free
From change, and therefore Things may
fall to nought—

CREECH.

You give me, replied the Marchioness,
nothing but Consequences and Verses, when
I want Proofs and Explanations.

Those, answered I, *Des Cartes* (who has
more copiously discussed this Subject than
Lucretius) will abundantly supply. Though
his Principles be different from those of the
Atomists, yet in this Particular they are
agreed. But Systems are what you demand,
and I must think of satisfying you—I
shall shew you some of the most daring Pro-
ducts of Imagination, which have, for some
time, misled those who assumed the pompous
Name of Searchers after Truth. The Illu-
sion is, at length, vanished; Philosophers
are grown more cautious and rigid, and
make a stricter Scrutiny into each other's Te-
nets, than the *Egyptians* formerly did into
the Morals of their Dead, before they
would admit them to the Honour of Se-
pulture.

Come,

Come, said she, let me hear this System of *Des Cartes*, I shall not be so severe a Critic, if it turns out that pleasing Work of Imagination, which you give me Reason to hope for.

It were pity, Madam, rejoined I, but that every thing, for the future, should be proposed to you, under the Form of a philosophical System.

You are to suppose then, that all the Matter, of which this whole World is composed, was, from the Beginning, divided into exceeding small Particles, of equal Size, and in Figure nearly resembling a Dye. Imagine likewise, that these Particles are continually moving in Circles, some round one Point, and some round another, and that they are, all the while, turning round their own Centre like a Wheel, which, in it's Progress towards any certain Place, makes many Revolutions about it's own Axis. Now the Points, round which these Particles move, are the Stars; Points, as you see, the most splendid and luminous in the Universe. From hence, Madam, you can suppose the Universe to be full of Vortices: (a Name given to any Mass of Matter that is whirled round a Point, or

common Centre, as you may observe Circles of Water in a River, or Dust that flies when it is agitated by the Wind.) I believe you will not scruple to allow the Sun, upon my Assertion, one of these Vortices to himself, as he is, in no respect, inferior to any of the Stars.

Not only so, answered she, but at your Request, I will allow him the largest and most magnificent Vortex of all. He deserves this at least, for those many Obligations we have to him.

Philosophy, Madam, replied I, is less prejudiced, and has no more Partiality for the Sun, than for the least Star in the Milky Way. I shall be satisfied, if you allow him a Vortex, no Matter of what Degree. From this Vortex, you shall see the Sun himself break forth (for I have hitherto only supposed him and the Stars, as already existing, meerly for the Ease of your Imagination) and with the Sun, all the Charms of *Light* and *Colours*, and I know not how many fine Things beside. In short, it is like an enchanted Palace, where you have only to call for what you want, and it instantly appears.

I must

I must not flatter myself, said the Marchioness, with the delusive Hope, that my granting so meer a Trifle can possibly procure me such Happiness as you promise.

Mathematicians, Madam, returned I, are thus far said to resemble Lovers, that however insignificant the first Favour you grant them may be, they know so well how to take Advantage of it, that they will lead you by Degrees greater Lengths than you ever designed to go. Now this *Des Cartes*, to whom you have made, what you reckon so slight a Concession, was a most able *Mathematician* — I have as little Skill, Sir, answered she, in the Finesse and Artifice of Love, as in that of the *Mathematics* and *Philosophy* — But it is past my Comprehension how any reasonable System can arise from these Vortices, which, after all, are nothing but Assemblages of extremely minute Particles, that keep whirling round some Point, at the same time that each of them turns round it's own Centre: Let them whirl and whirl on, I believe they will have little else to do.

There was as little Reason to imagine, replied I, that the accidental Meeting of a Hero and Heroine in a Romance, and a certain

certain *Je ne scai quoi*, which he discovers in her, could ever have furnished Matter enough to be spun out into twenty Volumes: And yet there are many Instances of this (perhaps too many) in a neighbouring Nation. What a Number of gallant Adventures (without having recourse to Fiction) might not that *Je ne scai quoi*, which all the World admires in you, produce? — Let us see at present, interrupted she, what *Des Cartes*'s Vortices will produce; for, after those twenty Volumes, I can't think anything impossible.

These little cubical Particles, proceeded I, (whereof you now begin to entertain somewhat a better Opinion) being thus rapidly whirled about their Centres, must necessarily strike with more violent Collision against each other, and of course break off those Angles or Points which obstructed the Freedom of their Revolutions. You know, Madam, that if you grind away the Corners of a Dye, it will become roundish, and in Proportion, as the Angles are gradually worn away, it will be reduced still nearer to the Figure of a Ball.

And this you are to believe was the Case with these Particles, which, by repeated

Collision, were at length changed from their first Figure of a Dye, to that of so many little Balls or Globules. The Matter which was broken off from these Angles, and which, by the continual Collision, must necessarily be reduced into very small and volatile Particles, did not yet remain unapply'd, but had it's proper Office. It immediately declared open War against the Vacuum of the *Atomists*, and threatned to destroy and banish it from the Universe, wherever it was to be found.

The first Undertaking of this Matter was to fill up the Interstices, which otherways would have remained between the Globules; for though they touched one another in particular Points, yet there must have been some empty Spaces between them, arising from the Nature of a globular Figure.

Without this Matter ground to Dust, there must have also been a great Void about the Centre of every Vortex, for the Particles of Matter originally cubical, in their being ground into Globules, lost a good deal of their original Size, and consequently found Room to recede farther from their common Centre, according to the Laws of centri-

centrifugal Force; by which Bodies moving in a Circle are thrown off towards the Circumference.

The broken Particles of Matter, now ground to Dust, were consequently forced towards the Centre of each Vortex, except what necessarily remained to fill up the void Spaces amongst the Globules, in which Situation they moved with the whole Mass, and became, as it were, the Soul of the System.

This most subtle and volatile Substance of all, which is called the *Matter of the first Element*, or the *Subtile Matter*, forms nothing less than the Sun and Stars in the Centres of the Vortices; as the Globules that turn round them, and which are called the *Matter of the second Element*, compose the Substance of the Heavens; and though the *Cartesians* have deprived it of that Transparency, and adamantine Solidity, that formerly rendered it so venerable among the Ancients; they have taken Care, however, to atone for this Injury, by making it the Original of Light, and by this Means it has gained more than it lost.

What! cry'd the Marchioness, are we got already to the Origin of Light? Your

Heroes and their twenty Volumes have made a very bad Use of their Time, compared with us — A little more Attention yet, answered I, and you will find they have made a much worse Use of it, even than you believe. The System of *Des Cartes* presents you a Scene, such as, I believe, you never beheld in the finest and most splendid Opera. The whole Extent of the Universe, vast as it is, is sown and filled with innumerable Vortices touching one another, of different Size and Figure, but all of them nearly round. These keep each other in a mutual Equilibrium, by their reciprocal Pressure. In the Midst of every one of these Vortices is a Star or a Sun, that is to say, a large Ball of *Subtile Matter*, that strives to dilate himself, and presses upon every Part of it's Vortex. This Pressure of the subtile, communicated to the globular Matter, or that of the second Element, gives Birth to Light according to the Opinion of *Des Cartes*. The different Size of the Star, and much more it's Distance from us, causes the Light of it to appear more or less lively to our Sight: And hence it is, that the Splendor of the Sun, in whose Vortex we are

—with

— with superior Blaze
Dims the pale Lustre of the starry Rays.

It is believed, that *Syrius*, though his Distance from us be more than two Millions of Millions of *English* Miles (according to the Calculation of a celebrated *Mathematician*) is yet the nearest Star that we have ; because it appears larger than any of the rest, and it's lively and sparkling Light makes the longest Resistance against the dazzling splendor of the Sun.

I suppose, said the Marchioness, that out of Partiality to your *Syrius*, you omit that Star which the *Peasants* call *Diana*, and the Poets the Harbinger of the rising Day, and to whom they give the same Honours as to *Aurora*.

You must take Care, answered I, not to confound two Things together, which are very different from each other, as a Body that is luminous in itself, and one that derives all it's Splendor from another ; or, in other Words, a Sun and a Planet. It is true, that all the Planets, as *Venus*, which, in the Language of *Astronomy*, is the same as your *Diana* ; *Mercury*, *Mars*, *Jupiter*,

Saturn, and our Earth itself, were anciently so many Suns, and may, perhaps, (for who can penetrate into the Secrets of Futurity) hereafter be again restored to that Honour.

I have not yet mentioned to you another Species of Matter, which is called the *Matter of the third Element*, and which has occasioned the greatest and most remarkable Revolutions that are left upon Record in the Annals of the *Cartesian Philosophy*. Among the Particles of that subtile Matter, of which the Sun is composed, there are some that by their rugged and irregular Figure unite and cling together, and by these Means form Masses that are sometimes bigger than our Earth.

These Masses are driven away from the Sun by the Laws of centrifugal Motion already mentioned and repelled to his Superficies. The Pressure that communicates itself from the subtile to the globular Matter; or, in other Words, the Light is interrupted in that Part of the Sun's Superficies where these Masses are placed, and from hence they appear to us as Spots, which, turning round with the Sun, eclipse Part of his Splendor and Glory.

Flattery; perhaps, made certain courtly *Astronomers* take these Spots for little Planets, that get betwixt the Sun and us, and made Use of them to transport the Families of those Princes to Heaven, from whom they expected some little Pension on Earth, in Exchange for the Investiture of a thousand Planets, which they, with great Confidence, promised them. Philosophical Politeness transformed these Masses into Patches upon the Sun's Face; if you are better pleased with the Idea, under which they were represented to the Queen of *Prussia* by the famous Mr. *Leibnitz*, who thought that philosophical Terms should be softned for the Ear of Queens. The Thing is too serious to bear a Jest, said the Marchioness, Patches as big as the Earth might quite demolish a Face.

Hitherto, continued I, our Sun has been lucky enough to escape this Misfortune. The Motion and Agitation of the subtile Matter breaks and dissipates these Masses as fast as they are formed. There once appeared one of these Spots, which darkned the fifth Part of the Sun's Disk. This was of a most enormous and terrible Bigness, enough to make *Astronomers* tremble, and the whole

World melancholy. The Sun at last disengaged himself, and got the better of it, so there is now no Reason to fear any such unlucky Accident ; but all the other Suns were not born under such favourable Circumstances. There are certain Stars which are considerably diminished, so that what has formerly been placed by *Astronomers*, among those of the second Magnitude, is now hardly worthy of being reckoned among those of the sixth. This must be ascribed to these Spots, which by Length of Time are so increased, as to form a sort of Crust almost over the whole Star, and consequently weaken it's Light.

On the other Hand, said the Marchioness, might not certain Stars arrive to a greater Magnitude, if the Agitation of the subtle Matter was strong enough to dissipate Part of their Crust? You are thoroughly possessed, Madam, answered I, with the Spirit of *Cartesianism* : This Sect places it's Glory in Conjectures, and you have made a very good one. But what a terrible Desolation would it make in the poor Star, if this Crust should entirely cover it (as it too often happens) and should be strong enough

to

to resist the Force of the subtile Matter, that strives to break and dissipate it.

When this happens, adieu Sun! adieu Star! It is now fallen from the fair Rank which it held before, it's Rays were obscured by the Crust; and from a luminous Body, which it was, it becomes opaque and cold; it's Vortex loses it's Equilibrium; as the subtile Matter round the Centre no longer presses on the Globules in the Circumference, the Vortex of some neighbouring Star hurries it away, and now become a Planet, it is whirled about at the Mercy of the more powerful.

These are the most remarkable Metamorphoses that can possibly happen, and to which our metaphorical Suns here below are no less subject. When they begin to lose their Lustre, and have nothing left to feed that Passion, which so agreeably flatters the Pride of the fair Sex, and which ought to be the Subject of your Philosophy; they are carried away, and become Slaves to another, which for their Consolation they call Virtue.

Our fallen Suns, answered she, have at least the Advantage in this, that they acquire a fine Name, and under the Shelter of

that, they, with great Authority, condemn what is no longer in their Power to practise, and in some Measure recover their lost Empire. But what Consolation is there for a miserable Sun above, when it is enveloped with a Crust, and changed to a Planet?

The Consolation, answered I, of not having an odious and imaginary Empire, after having been possessed of an amiable and real one ; the Consolation, in short, of not growing like an old *Sibil*, after having resembled you.

This miserable Metamorphosis of a Sun to a Planet (accompanied however with some Degree of Consolation) is probably what happened to a fine Star, which we have entirely lost in the Constellation of *Cassiopeia*; and this too, according to the *Cartesian* System, was the Fate of our Earth, which was once Empress of an extensive Vortex, crowned with Light, and one of the brightest Eyes of Heaven ; but at length, enveloped with a deformed Crust, unhappily lost it's Power and Splendor, and was carried away by the immense Vortex of the Sun, as a Straw in a River by the Impetuosity of a Whirlpool : In the same Manner, the other Planets that revolve about him,

Jupiter,

Jupiter, Saturn, Mercury, Mars, and Venus, fell Victims to his superior Power; nor could even the Comets escape, though these are Planets of a peculiar Nature, which keep rambling from Vortex to Vortex: And, like certain People among us here below, rove from one Country and Government to another. And these Vortices are the grand Machine invented chiefly by *Des Chartes*, to guide the planetary Dance round the Sun.

Is the Earth then, replied the Marchioness after a short Pause, like the other Planets, forced to dance round the Sun? And do all the mighty Preparations, you made with your Matter of the third Element, amount only to this?

The Earth, answered I, does not need that Concern which you shew for her Degradation from a Sun, to the inferior Rank of a Planet; since, by this Means, she was destined to give Birth to you, who are but another Name for the most charming Thing, that all the Vortices of the Universe put together could ever have produced. Is not this a sufficient Compensation for her Loss?

If it was in the Power of Gallantry, answered the Marchioness, to make her amends, your's would certainly do it. But

what can ever free her from the Disgrace of being obliged, among the Crowd of other Planets, to whirl round the Sun like a Straw in a Whirlpool? I am sensible that you Philosophers look upon the Earth with great Indifference, and suffer it to turn round without Regret; but for my Part—

Let it whirl round for this time, interrupted I, upon the Word of *Des Cartes*. Hereafter, if you have a Mind to be convinced with Pleasure, we will read Mr. *Fontenelle's* Dialogues upon the Plurality of Worlds. There you will see a Marchioness, who exactly resembles you in every Accomplishment of Mind, and in whom you have nothing to envy but her Philosopher. At present you are to look upon the Earth only as a Composition of the Matter of the third Element, which renders it opaque, and as a Body which no longer shines by it's own Light; and by this Means, I believe, you will be pretty indifferent towards it. A Gloworm, one of those Reptiles that glitter by Night in the Country, is much more worthy your Attention; whatever is not luminous is nothing to us.

You have seen, continued I, what sort of a thing Light is: You see too, how the Sun

Sun may continually supply so great a Quantity of Light as he does, without any Expence to himself, which is what gave you such terrible Apprehensions in the *Atomic* System. He has nothing to do but to press the globular Matter, and this Pressure costs him nothing of his own; and since it is communicated on all Sides, we are to conclude, that he is luminous quite round.

The Light, according to *Des Cartes*, is but a Moment in it's Progress from the Sun to us, notwithstanding the Distance of a Million of Miles. The Globules of the second Element are continued from the Sun to the Earth, like so many Strings of Beads, and touch one another. In the Instant that the first in the String moves, or endeavours to move, it must also endeavour to move the last; just as a Wand, though ever so long, in the Moment that one End moves, the other moves also.

I find, replied the Marchioness, all this means only, that these Vortices are to serve as a Reason for every thing. In a Moment's time we have produced the Sun, Stars, Planets, Comets, the Earth, and Light. I

suppose

suppose we shall form Colours with the same Facility.

Nothing more easy to *Des Cartes*, answered I. As the Motion of cœlestial Matter is that which strikes us with the Sensation of Light; so from the Diversity of that Motion it is, that we receive the various Sensations of different Colours, which, in reality, are nothing more than the different Modes in which Bodies receive that Light, and return it to our Eyes. And these again depend upon the different Degrees of Rotation in these Bodies.

As for Example, the Bodies, whose outward Parts are most dispos'd to reverberate the Globules of Light, which fall upon them, must necessarily transmit them with greater Force to our Eyes, and therefore they appear *Red*. Those, whose Velocity is encreased in the second Degree, appear *Yellow*. Those, less again, in the Force of their Transmission, *Azure*. And, fourthly, those, whose Rotation is still less, as well as the Force of their Reflexion, appear *Green*. Again, those Bodies, which, without any Encrease or Diminution, reflect those luminous Globules, give us the Sensation of *White*. And, lastly, such as utterly

terly extinguish them, and absorb them within themselves, appear *Black*. There's *Light* and *Colours* for you. Do you desire any thing more? 'Tis only speaking; the Vortices are as useful to *Des Cartes*, as the Cocao-tree to the *Indians*, which supplies them with all they want.

No, no, said the Marchioness, let us at present confine ourselves to Colours: I need only increase or diminish the Motion of Rotation in the Globules of Light, to have them all, to form the Shades of a genteel *French* or changeable *Indian Silk*; and variegate the Parterre of a Garden with the different Beauties of *Hyacinths*, *Anemones*, and *Violets*: In short, to diversify the Face of Nature just as I please.

Rather, said I, if this Increase or Diminution should give you any Trouble, you need only suppose the Globules of Light to be entirely deprived of all Rotation, which we will grant them only in the very Action of variegating your Silk or Parterre; or, in other Words, in being repelled from the Bodies, upon which they fall. You may freely choose which of these Methods is most commodious, each of them will equally serve your Purpose. *Des Cartes* seems to

have

have had this too in common with the Physicians, that he thought it unworthy his fruitful Imagination to confine himself to one single Method of making his Designs succeed.

Notwithstanding your malicious Insinuation, replied the Marchioness, I think myself much obliged to *Des Cartes* for this Copiousness; I dare say it will not fail him, in explaining how it comes to pass, that one Body should give the Globules of Light a certain Rotation, and another Body a different one.

You are not confined here neither, answered I, but have free Liberty of choosing what Method you like best for the Explanation of the thing in Question, either different Figures of those Particles, of which the Superficies of Bodies are composed, or their different Dispositions, their different Inclination towards each other, or their being more or less smooth; and a Thousand other Things that you may imagine to yourself. By these Means will your dexterous Philosopher compose, not only the Finery of Silks, and the variegated Beauties of a Garden, but all the Elegance of *Paul Veronese*, or the Delicacy of *Titian*; and hence too arises

rises that lively Bloom on your Complexion, which, perhaps, not all the Art of *Paul Veroneſe* and *Titian* could ever have imitated.

I should not have thought, answered she, that my Complexion would ever have entered into the *Cartesian* System.

It enters, answered I, into other Systems more generally understood, and of somewhat more Importance than those of Philosophy; but even these must receiye great Honour from the Explication of so beautiful a Phænomenon.

I protest, said the Marchioness, that this great Plenty of Causes, and above all, the Simplicity that reigns throughout this System, quite charms me not to say any thing of those Difficulties, which it removes in all the rest. I should be glad to see how any other Woman in my Place would guard against it.

I am too well acquainted with the Language of Ladies, answered I, not to believe you already conquered. You have not sufficiently closed your Ears to the Song of this philosophical Syren, nor guarded your Heart against the alluring Pleasures in the luxurious Garden of this *Cartesian Armida*; but you have forgot that yourself

at

at first condemned this Precipitation in building Systems, which cannot afterwards bear up against the Obstinacy of Observators. Hypotheses or imaginary Systems cannot long resist the Force of Experiments, which are justly called by a Man, who carried them farther than, perhaps, any one that may follow him, natural Revelations. A Liar, even if he was as ingenious as he in *Corneille's Comedy*, will at last be found out.

I had no Notion, said she, that so many Things could have been produced from so little a Matter, as these whirling Particles; and, I think, upon this Account, a little Precipitation might be excused, and all this Moralizing laid aside. I am extremely fond of the *Chinese*, because I am told they effect whatever they take in Hand with much fewer Instruments and less Apparatus than we do: And, I think, *French Musick* much preferable to ours, because by a few simple and plain Notes it touches the Heart and moves the Passions; whereas ours, with all it's Divisions, Fugues and Shakes, leaves us, for the most Part, in a tedious and stupid Tranquillity. Those, who for every little thing make Use of such great Machines,

put

put me in mind of the Dictators anciently elected at *Rome*, with the utmost Solemnity, and who never omitted choosing a Master of Horse for no other End than to fix a Nail in the Capitol.

You may add, said I, since you seek for Examples illustriously ridiculous, those Kings of *Perſia*, who never eat, walk, or go into the *Seraglio*, 'till an *Astrologer*, after many Observations and Calculations, has assured them, that it is a lucky Time to undertake one or other of these important Enterprises. If we had been in *Perſia*, how many *Astrologers*, how many Calculations must there have been employed before you could have been made a Philosopher? which I take to be a Thing of much greater Importance than the Walk of a King.

I am afraid, answered she, that before the *Astrologer* had finished his Calculations, my Inclination for Philosophy would have left me; but, Thanks to my good Fortune, that I was born in a Country, where, if we have a Mind to walk or hold philosophical Conversations, we may do either without giving the Stars or Sky any Trouble about it.

You ought rather to thank your good Fortune, Madam, answered I, for being born

born in a Country where your Charms are not like those of the eastern Beauties, confined to the narrow Limits of a *Seraglio*.

With these Reflections of your's, said the Marchioness, you will make me lose Sight of our Colours, whose Variety charms me the more, because the Production of them cost me so little Trouble. But how shall we produce those various Colours, which appear in looking through a certain Glass, which I once saw placed over-against a Window? Perhaps you have some other Sort of Motion to produce these Colours, which only appear to be in Objects, when they are looked upon through one of these Glasses.

You may form these, answered I, in the very same Manner as the first: You need only make the Globules of Light, that pass through the triangular Glass you mentioned (which is called a Prism) turn round according to those Rules you have already learnt, and according as the Variety of Colours, which it produces, require. As to that Distinction which you seem to put between those Colours, which are really in Bodies, and those which are so only in Appearance, *Des Cartes* will not grant it you, for he as well as the

the Atomists (as you may remember) asserts, that there are absolutely no Colours in Bodies, and that they only appear to be so. Thus for Instance, betwixt the Red on your Cheeks, and that in the Rainbow or Prism, there is no sort of Difference; only perhaps it would be more pleasant to make Observations on the one than on the other; but after all they are of the same Nature, and only appear to exist.

Do you think, continued I laughing, that so many Poets would have compared fine Ladies to the Rainbow, if there had not been some Resemblance in their Colour? As for Example, one of the greatest Poets in our Time has done in those sublime Verses, where he is describing some Beauty, who, perhaps, resembled you.

Thus op'ning wide the golden Gates of Day,

The rosy-finger'd Morning takes her Way,
Deck'd in the glowing Purple's richest Hue,
Bedrop't with glittering Gems of spangled Dew.

Thus, when the Clouds o'ercharg'd with
Vapours pour
Upon the thirsty Glebe a vernal Show'r;

Iris

Iris her lucid various Bow on high
 Gayly displays, and sooths the weeping
 Sky.
 The boist'rous Winds are hush'd in deep
 Amaze,
 And Ocean stills his angry Waves to gaze.

You see, said I, that one of the most splendid and pompous Similies, that the Poets have in their whole Collection, would have been guilty of too essential an Error.

Seriously, answered the Marchioness, I always thought that the Colour on my Cheeks, whatever it be, was really there, and that the Colours in a Prism, or the Rainbow, were only in Appearance: Pray explain this Paradox to me, which, to say Truth, I am very much perplexed with; and deliver me from the Uneasiness I cannot help feeling on your comparing me to the Rainbow, notwithstanding you made me a great Compliment by this fine Simile.

This, said I, is reducing Things to that Simplicity you seem so fond of, by taking away the Distinction which you put between real and apparent Colours. But the Interest you have in this Distinction, and your Self-Love, that makes you tremble at the

Thoughts

Thoughts of losing your Roses and Lilies, (to speak in the Pastoral Stile) has at present got the better of your Love of Simplicity. I'll engage there are but few Ladies who would be so scrupulous: But after all, you cannot, with Honour, adopt a System without being willing to admit the Consequences.

We have before said, that there is in Bodies only a certain Disposition and Texture of Parts, and in the Globules of Light a certain Rotation which these Parts give them. These Globules in a certain Manner, tickling and shaking the Nerves of the Retina, which is a very thin Membrane at the Bottom of the Eye, give us the Idea of some Colour, which we, by the Help of our Imagination, refer to the Body, from whence these Globules of Light are derived to us.

But I think we are called to Dinner, and 'tis Time for us to see what Taste our Imagination will help us to give the Soup.

Our Imagination, replied the Marchioness! I do not know whether he, who has laboured these three Hours to give it a real Taste, will be very well pleas'd with you philosophical Gentlemen, who would reduce every Thing to meer Appearance. I dare say, answered

I, that he will give himself very little Trouble about such a Trifle as a philosophical Opinion. But however if he did, he must bear it; for as Bodies are in Reality without Colour, so they are likewise, without Taste, Smell, Sound, Heat, Cold, and even when they appear most luminous, without Light.

The Marchioness was very desirous that I should explain this Paradox more fully; but I assured her, that if we stay'd 'till the Soup wanted heating again, not the finest and most simple Explications in the World would help our Imaginations to give it a good Taste.

She was fully convinced of this Truth, and we ended our Discourse in the Manner of *Homer's* Gods, who, after their Consultations, are sure never to forget their Ambrosia.





ENTERTAINMENT II.

That Qualities, such as Light, Colours, and the like, do not really exist in Bodies. Some Metaphysical Doubts concerning the Sensations we have of them. An Exposition of the general Principles of Opticks.



URING all the Time we sat at Table, the Marchioness was earnestly employed in giving different Degrees of Rotation to the Globules of *Light*, according as the Variety of Colours, in the Objects around her, requir'd; and in this Attitude she considered herself, as she said, as the sovereign Lady, and absolute Ruler of Nature, having it in her Power to diversify it at her Will and Pleasure: But as

soon as we rose from Table to take a Walk in the Garden, I am ready, began she, to disavow any Taste in the Soup, and to renounce, willingly, every Colour, even those I was most fond of; in short, I am willing to become a thorough *Cartesian*, if you can only support me, with convincing Reasons, for the Change. There may, to say Truth, strange Consequences be drawn from this System of Globules; but perhaps they will themselves furnish me with some Expedient to evade those Consequences.

I see, Madam, replied I, you wou'd fain make the same Use of Philosophy, that Attorneys do of Law; but Expedients will never abide the Test at the severe Tribunal of Reason. Not all the Potentates of the Earth, nor the more powerful Beauties can influence the impartial Judgment of Philosophy, nor obtain a false Interpretation of the smallest Text in their Favour at that rigid *Areopagus*. This is one of the Trials, one of the Mortifications which *Des Cartes* makes you undergo, in your philosophical Noviciate.

But what, does this small Difficulty fright you? Take Courage and fear nothing, you will at last add to the Pleasures you now receive

receive from your Senses that farther one of contending with them and giving them no Credit.

Hitherto, continued she, I have only the Dissatisfaction to find that we are under a continual Illusion; for if what you say be true, Things appear to us extremely different from what they really are. We see Objects distinguished by this or that *Colour*; whereas no *Colour* really exists in them; it is only a certain Disposition of Parts: We perceive that they have Taste; that they are hot, that they are cold, and yet they are not, in Truth, possess'd of any of these Qualities. Indeed I cannot help thinking that we are in a very unaccountable Situation.

It is certainly very strange, answered I. Our Knowledge can make but very little Progress unless it be conducted by the Senses. They continually make us believe Things, which a more refin'd Sense, or our Reason, farther inlightened, afterwards contradicts. You think, for Instance, that your Hands, which have been the Subject of so much elegant Poetry, are smooth and polished; and possibly might be greatly offended shou'd any one dare to dispute their having those Qualities: And yet if you were to

look upon them through a Microscope, you wou'd be surprised to see a great Number of Pores that separate their Texture; and to find that they are covered with Scales like the Skin of a Fish. You wou'd discover in them Cavities, Eminencies, Valleys and Hills, Receptacles for a Nation of little Animals, who, perhaps, spend their Life there: And, to encrease your Wonder, you would be presented with the Sight of Rivers and Seas. In short, you would no longer own them for those Hands, formed by Love and the Graces, so often the Subject of the Poets Song.

Nature, said the Marchioness, has done us a great Favour, in not making our Senses too refined. It would be very bad for us if our Touch was exquisite enough to feel all that the Microscope discovers to our Sight. We should certainly be extremely unhappy, returned I, if our Sensations were so perfect that in touching a Surface, seemingly soft and smooth, our Fingers were every now and then to plunge into a Pore, or be stopped by a Swelling. It is to our Reason's not exerting itself, and to the Grossness of our Senses that we owe our most voluptuous Enjoyments; and Happiness was truly

truly defined a tranquil Acquiescence under an agreeable Delusion.

It must be confessed, replied the Marchioness, that our Sex is greatly obliged to the Complaisance of Philosophers, who, notwithstanding they are so well acquainted with the Nature of our Superficies, are so genteel as to behave towards us like the rest of Mankind. But if I had a Mind to charm any ignorant Person, the very first Thing I would do should be, to forbid him the holding any Correspondence with those Gentlemen who deal in Microscopes; for these might do me a very great Prejudice.

Not all the Microscopes, nor all the Philosophy in the World, answered I, could ever hinder your appearing lovely to the naked Eye, and even a *Cleopatra* might be contented with this. *Virgil* makes *Corydon* warn his *Alexis* not to confide in his beauteous Colour.

Trust not too much to that enchanting Face;
Beauty's a Charm, but soon that Charm
will pafs.

But I may safely encourage you to trust—
To the smooth Surface of your snowy Arms.

As our Senses, if I may use the Expression, are not Microscopes, so neither are our Hearts Philosophers: We should pass our Time but dully if our Pleasure was in the Hands of Philosophers; and if Beauty, in order to prove it's Existence, must stand out against all the Experiments of a *Naturalist*. One may as well affirm that the Chastity of a Lady should depend upon the ill grounded Suspicion and diligent Enquiry of a jealous Husband. These two Kinds of Men have this in common, that the Searches of both equally tend to destroy the most rare and valuable Things in the World.

But Philosophers, said the Marchioness, have no Mercy when once they set about Destruction: For pray, what do they leave to Bodies, when Colour, Taste, and those many other Qualities, which they take from them, are gone?

They leave them, answered I, in the Possession of Extension, (that is Length, Breadth, and Depth) Impenetrability, Motion, Figure, and all the fine Things that Mathematicians and Mechanics deduce from these Qualities, upon which I could produce you so many formidable Volumes, that all which has been written upon the *Crusca*, would

would seem compared to these as concise as a King's Declaration of Love.

Do not you think it enough for Bodies to be as much as Bodies can be? Besides what Philosophers do, with Regard to those Qualities we were speaking of, is not properly a Destruction: They take nothing away from Bodies, but what was falsely applied to them, and what they had long unjustly possessed; and restore those Qualities to us, to whom they rightly and properly belong. Prescription has, at present, no Influence on Philosophy, as it formerly had. If a Lover, for Example, should say, that there was Hope in a certain favourable Glance, darted on him from behind a Fan, what Harm would a Philosopher do, who, without destroying either the Hope or the Glance, should tell him that there was nothing in the Glance, but a particular Motion of the Eye, caused by certain Muscles, and proceeding either from a Principle of Pity, or perhaps (if we would trace the Thing to it's true Original) Coquetry? But that the Hope was entirely in himself, and excited by the Means of that Glance.

Just in the same Manner, when we are pricked with a Needle, the Pain is entirely

in ourselves ; and there is nothing in the Needle but a Motion, by which it disjoins and lacerates the Fibres of our Body : This Separation is the Cause that we feel Pain. In short, Bodies are only material Substances, and consequently can have no Properties but what depend on Matter ; and these the *Cartesians* have confined to Extension, mutual Impenetrability, Diversity of Figure and a different Disposition of Particles : And these are sufficient to give Bodies a Power of exciting different Sensations in us, as those of Light, Colours, Taste, and the like.

It is not necessary, for Instance, that Colour should really be upon the Surface of the Body, in order to make me see that Colour, any more than it is necessary for Pain to be in a Needle, in order to make me feel it when I am pricked : It is sufficient that as the Needle causes a certain Disposition in the Fibres of my Body, by the Means of which I fell the Pain : So that particular Rotation, which is in Globules, repelled from the Surface of a Body, should cause another Motion upon the Nerves of the Retina, which, carried from these to the Brain, excites in me the Idea, or as they call it, the Sensation of Colour.

According

According to the same Principle, if in any Body there be a certain Motion capable of pressing the Globules, and darting them to our Eyes, the Impression, which they make on us, will awake in our Souls the Idea of Light. A certain Configuration of Particles, or perhaps certain little Animalcules, which are in Bodies, by stimulating the Nerves of the Tongue, in such, or such a particular Manner, raise in us the Sensation of this or that Taste. These Sensations are generally raised in us, by Means of certain Bodies; and because we see neither their Particles, nor the little Animals which are in them, the Globules of the second Element, nor the Impression which is made upon our Nerves, we ascribe to those Bodies both Light, Colour, and Taste, which, in Reality, are only in ourselves.

Reason, at length, convinces us of the Illusion-which our Imagination continually puts upon us, and assures us, that the delightful and hitherto undefined Taste of the Pine Apple, the pleasing Verdure of a Meadow, and even the Light of the Sun, which animates and revives the whole Universe, are not essentially in them, but all belong to us.

I understand you, said the Marchioness, we are enriched at another's Expence, and, like ancient *Rome*, found our Grandeur on the Spoils of the whole World.

Philosophy would be in a bad State, answered I, if it's Rights had no better Foundation than those of Policy and Ambition. I see you have not yet a right Notion of it: But in order to convince yourself that Philosophy is no Usurper, and only takes it's Due, press one Corner of your Eye with your Finger, and you will see, on the opposite Part, a round Flame of a reddish Colour. In this Case, your Eye certainly sends forth neither Light nor Colour; the only Reason of your seeing them is, the Pressure which your Finger makes upon the optick Nerve.

The Globules of Light which flow from the Surfaces of Bodies, occasion upon the Eye the same Effect as your Finger does, only their Operation is more delicate and imperceptible.

The different Disposition and Configuration of the Particles of a Body, are the Reason why the Globules make different Impressions upon us. The Power of a Body's exciting in us the Idea of any particular Colour.

Colour consists entirely in this Disposition, and the Configuration of it's Parts. Is it not evident from hence, that if this Disposition be changed, the Colour is changed also? which could not happen if the Colour was really in the Parts of the Body itself. Coral, which is of a bright Red, if it be ground to Powder turns pale; one Liquid mixed with another changes it's Colour. The Reason of all this is, that the Disposition and Configuration of the Parts of these Bodies are changed by being ground or mixt, and from hence they transmit the Light to us in a different Manner, and consequently change our Idea of the Colour; from no other Reason proceed the venerable white Locks of old Age, the transient Whiteness of many Animals of the North in Winter.

From hence too it is, that certain Roses in *China* are in the same Day both White and Purple. From this Cause arises that surprising Variation of Colour, which generally follows the Change of Passions in the *Camelian*, which has furnished the Moralists and Poets with so many Allusions, the Ancients with so many Fables, and the Moderns with so many fine Observations. And

lastly, what is it else but a Difference in these Dispositions, that makes you Ladies, at your first rising in the Morning, only appear as meer mortal Beauties ; but after two or three Hours employed in the sacred Rites of the Toilette, sends you forth like Goddesses dazzling our Sight, and commanding our Adoration ?

I perceive, replied the Marchioness, that there is nothing impenetrable to Philosophy ; we may hide ourselves from Men, but not from Philosophers ; and indeed to what Purpose would it be for us to endeavour to conceal ourselves from a Set of People, who are quick-sighted enough to discover the Globules of Light, indued with a certain Motion, and those Nerves and Fibres to which this Motion is communicated, and thence conveyed to the Brain ? A Sight which Mortals Eyes have never reached. But I must confess I stand in Need of your Assistance, to guide me through this obscure Labyrinth. I do not see what Relation all these Motions have to any Colour, that I have a Conception of ; for Colour seems to me a thing quite different from these Motions.

Have

Have you any better Conception, answered I, of the Relation between the Idea of Pain, and a Separation of the Fibres of your Hand? or between the Idea of Hope, and a certain Motion in the Muscles of an Eye? And yet you see that these Things are, in Fact, connected, and that the one is the Cause, or, at least, the Occasion of the other. You seek for more than it is possible to give you. Unhappily for us! Those Things which are of the greatest Importance to human Knowledge are the most doubtful. Who can tell you in what Manner Objects occasion certain Ideas in the Soul, and how the Soul, on the other Hand, gives certain Motions to the Body? How the Soul, which is unextended, yet is present in every Part of our whose Machine, and though incapable of being seen or felt, yet sees and feels every thing.

Philosophers can, with a great deal of Ease, transmit the Motion of the Globules of Light (or any other Motion) to the Nerves, and from these to the Brain, where they all terminate, either by Means of a Fluid that runs through them, or a certain Vibration raised in them. Nay, Philosophers will go yet farther, and transmit this

Motion

Motion to certain Parts of the Brain, which are imagined to be the Seat of the Soul ; but how these Motions, when they are arrived to the Brain, or Seat of the Soul, should produce in it different Ideas, is an absolute Mystery.

This Passage, which, in Appearance, is so short, is to Philosophers what the innavigable Ocean was to the Ancients. What Communication, what Connexion can there be between Body and Soul, between Extension and Thought, Motion and Idea, Matter and Spirit ? What sort of Communication these can have with one another, is beyond the Reach of our Imagination.

The same, answered she smiling, that *Aeneas* had with the Shade of his Father *Anchoris* in the Elysian Fields. They mutually communicate the most agreeable Things in the World to one another ; but when *Aeneas* attempts to embrace the old Man, he vanishes away like a Dream, and is dissipated into Air.

We may draw a fine Allegory from this Hint, answered I, which would have done great Honour to one of the musty Commentators of the last Age. Now, in order to put your Allegory in a clear Light, and to

let

let you see, on the other Hand, that nothing is able to discourage a Set of People, brought up and educated in the Midst of Difficulties ; some of them will tell you, that there is a certain Correspondence or pre-established Harmony betwixt Soul and Body, so that, though they have no more Connexion with each other, than an Harlequin-dance in our Opera's has with the Death of *Dido*, or the Fate of *Rome* ; yet, by Virtue of this pre-established Harmony, at the same time that certain Motions happen in the one, certain Ideas and Desires arise in the other. In short, that they are like two Clocks independent of each other, whose Weights are adjusted in such a Manner, that when this strikes one, that shall always strike two, and so on.

Your *Des Cartes* will tell you, that upon Occasion, when external Bodies in the material World excite certain Motions in our Bodies, the Soul sees certain Ideas in the intellectual World. So that in the material World, Madam, you are composed of nothing but Extension, Motion and Figure. As to those other Qualities you possess, which render you so agreeable and charming, they have their Existence only in the

the intellectual World. Others will tell you, that by Means of certain Motions in the Body, God reveals and displays certain Ideas to the Soul ; but they have so little Regard for any Connexion between these Motions and our Ideas, that they affirm, we might as well hear with our Eyes, or see with our Ears, provided the Laws of Union between Soul and Body were different from what they now are ; a thing not impossible to God, since these Laws are merely arbitrary in him.

One of the Laws of this Union is, that when there are certain Motions impressed on one of the Membranes of the Eye, it should raise in us the Idea of Light ; and in the same Manner, when certain Motions are made upon a Membrane of the Ear, we should perceive the Idea of Sound. And as these Things are independent of one another, why might not the Idea of Light arise from certain Motions upon the Ear, and that of Sound from certain Motions impressed on the Eye ?

And why, said the Marchioness, may we not rather suppose that there are some secret Dependencies between these Things, which you Philosophers may not have been acquainted

acquainted with? The Vulgar hide their Ignorance under the Vail of Obstinacy, and do not the Learned endeavour to conceal theirs in Doubts and Questions?

Your Question at least is reasonable, answered I; our Horizon is but faintly illuminated with the Beams of a glimmering Twilight, and we pretend to see as clearly as if it was full Day: We continually act (especially with regard to *Metaphysics*) as *Columbus* would have done, if he had pretended to write us a compleat Description of *America*, and given an Account of it's Inhabitants, Rivers, and Mountains, when he had only seen a little Tract of this Country, and did not know whether it was an Island or a Continent. We reason upon the *Chimeras* of our own Fancy; we destroy and build Systems; we raise Doubts, and think to solve them without agreeing upon so much as their first Ideas.

One of the most elegant Genius's of *England*, who, in our Days, has revived the polite and agreeable Literature so justly admired in that happy Isle, under the Reign of *Charles the II*, in a little but very valuable Piece which he wrote against one of the most celebrated *Metaphysicians* of our Time,

Time, compares those Gentlemen to fine Riders in a Manage, who show their Address and Dexterity by making their Horse go backward or side-ways, and all Ways; and at length, after having laboured round and round for two or three Hours, dismount just where they got up. However it be with these metaphysical Jockies, it is certain, that some Things produce others very different from themselves.

The *Americans*, without Doubt, would be extremely surprised to hear that certain Cyphers, as the Letters of the Alphabet, could transmit the History of a Nation to Posterity, and furnish two People with Means of communicating their Thoughts, quarrelling or making Love at the Distance of four thousand Miles, just as well as if they were present with each other: And would not a *Chinese* be greatly astonished to see, that certain Marks, drawn upon Lines, should produce Sounds, Concords, and in short, a Confort of Music?

As I imitate these in their Surprise, replied the Marchioness, I will imitate them too in their Docility, which they discover in embracing whatever we teach them. As reasonable, even at the Expence of their Self-

Self-love. We must then solemnly abjure all those Charms which you call Roses and Lilies, and submit to that Philosophy which deprives us of them ; perhaps to give us in Exchange some greater Good.

I admire your Moderation, answered I, in agreeing to this *Cartesian* Philosophy, which, to say Truth, is somewhat injurious to the Fair. When the Philosophy of *Aristotle* was in Vogue, who asserted, that Qualities were really in Bodies, the Ladies might be somewhat more vain of their Beauty : But now they must renounce the very Things upon which that Vanity was principally founded : It is true, that with Globules alone, or a bare Disposition of Parts, you will still continue to make the same Conquests as you did before, with the Help of Colour itself ; but it is true on the other Hand, that Colour is now forever gone without any Hopes of being recovered again. However, if you are afraid that this System may do you any Sort of Injury, you need only name the happy Mortal you have a Desire to please, and I will promise you never to let him into the Secrets of Philosophy.

'Till there appears another System to deprive us of that Disposition of Parts which this

this leaves us, replied she, I do not see that we have any Thing to fear; since, after all, one certain Disposition has only one certain Idea fixed to it: So that the Disposition which excites the Idea of a fine *Red* in you, can produce that of a *Yellow* or *Olive* in another Person; and thus I think we are secure.

I am confident, answered I, that no philosophic System whatever can weaken the Empire of the Fair: But that a certain Disposition of the Parts of a Body should excite the same Idea in all Men, is what I cannot assure you of. Who can tell whether the Leaves of these Trees, that I see of one Colour, which I call *Green*, may not appear to your Sight of another Colour, which I should call *Red* or *Yellow*, or perhaps of some other Colour, which is, as yet, new to me?

Oh Sir, this is pushing Things to an Excess, said she; you would make me so philosophical that I should be a Pest to Society. You have made me already rob Bodies of Light, Colours, Taste, Smell, and every other Quality which People have never made any Scruple to grant them, and would be greatly offended at any Attempt to take them away. But not content with all this,

you

you would have me confess that a Colour, which appears *Green* to some, should seem to others *Red*, *Yellow*, or some imaginary Colour. Is it possible to offer a greater Affront to Mankind, than to contradict a Thing they are so certainly persuaded of; and to assert that they do not all see Colours in the same Manner?

Nay, I will venture, replied I, to tell you still more; it is impossible for any one, who has ever conversed much with Mankind (whom you seem so fearful of offending) to preserve the least Deference for them in this Point. Who can tell whether these very Trees, which I see of one certain Height, may not appear to you of another? So that what I, for Instance, call ten Foot high, may appear to your Eyes of a Height which I would call eight, or twenty Feet.

Pha, you banter me now, said the Marchioness, interrupting me: We both agree in calling this Tree so many Foot high, as well as in calling the Leaves *Green*. How then can what you say be true?

We agree, answered I, in Words, but perhaps not in Things. Two Nations, one of which should give their chief Magistrate, upon whose good or ill Administration de-

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pend the Life and Properties of his Subjects, the Name of *King* ; and the other, should give the Name of *King* to a chief Magistrate, who is only the Ratifier, and Guardian of the Laws of Nature, to which he, as well as the rest, is subjected. These two Nations would both agree in the Sound, by which they denote their chief Magistrate, but not in the Idea which they annex to this Sound. Both you and I had a certain Measure at first shewn us, which, tho' it appears to you of a different Size, from what it does to me, yet both of us agree in calling it a Foot, because we were told that Mankind distinguished such a Measure by that Name. According to this, which is the Rule of our Mensurations, we both say that this Tree is so many Foot high, tho' it may appear to me of a greater or less Height than it does to you ; and so every other Thing in Proportion to the different Idea we may possibly each of us have to a Foot. Who can tell then, but you may appear to yourself, and I to you, like one of *Gulliver's Brobdingnagians* ; on the contrary, each of us may appear, to my Sight, as small as a *Lilliputian* does to your's ; and who knows too but you may see the whole World after,

the

the Proportion of my *Brobdingnagian*, and I see them of the Size of your *Lilliputian*: So that if it was possible for us to see with each other's Eyes, (which would be an advantageous Exchange for me) you would despise the diminutive Size of my Colossuses and I should tremble at the Gigantic Stature of your Pigmies. We may easily transfer the same way of reasoning to Colours. We here too agree upon Names, but may very probably differ in Things. Each of us, for Instance, calls the Leaves of this Tree *Green*, because we were at first told, that the Colour of Leaves was *Green*: But it is possible that if Things could appear to your Eyes, as they do to mine, you would be surprised to see these Trees, and the whole Country, clothed in a Colour, which you, perhaps, might call *Purple*, or some other. But because we see that all Men resemble one another in the Make of their Bodies, when they have all two Eyes, one Mouth, two Legs, and two Hands, we are led to imagine from thence, that they must all resemble each other in their Ideas; and from hence arise many Inconveniencies in Society, which would not have happened, had Men been a little more philosophical.

From hence it is, that a Politician, when you are thinking on something quite different from his Projects, will plague you with a long Account of the Intentions of all the Privy-Councils in *Europe*, and the Partition which he has already made of *Italy*; for he thinks it impossible that a Man, who resembles him in his outward Appearance, should not equally interest himself in his visionary Schemes. From the same Cause, a Lover will talk you dead with the History of his continual Sighs and hopeless Passion. In short, this mistaken Notion gives Birth to numberless other Inconveniences in Society.

None greater, said the Marchioness, than the Philosophers occasion, who endeavour to reverse the Ideas that Mankind have formed to themselves, and make us believe that we do not all see the same Thing of the same Size and Colour. Cannot you find some Method to make me comprehend, whether the World really appears so different to different Persons, as you say it does?

It is not possible, answered I, to find such a Method as you require, unless there could be any one Measure which all Men were certain of seeing absolutely of the same

same Size and certain Colours, which, in the same Manner, they could be assured, appear the same to all Eyes, and to these they might refer all other Colours, as well as all other Sizes to the Measure.

As those two People, who make use of the same Word King, to signify their chief Magistrate, though the one be in Effect very different from the other, can never come to a clear Explanation of the different Ideas they would annex to the same Word, unlesf they define and compare it with other Words and Ideas more simple, such as both Parties are agreed upon. Now *Red*, *Yellow*, and the smallest imaginable Measure, are in themselves such simple Ideas, that they can neither be defined nor compared with other Ideas more simple. Consequently we have no Way of knowing, whether all Men have the same Conceptions of them or not, so that Mankind are much to blame in being so confident, that the World appears in the same Manner to all ; for it is great odds, but they are mistaken in this Affair.

But what ill Consequences can there possibly follow from our saying, that the World appears to every single Man different from what it does to all the rest ?

Nay, if we should go farther, and say, that even the World itself does not exist, and that all these Bodies, this Sun, these Stars, and these fine Ladies, are nothing else but Dreams and Apparitions.

There is one Philosopher who affirmed, that a Person need only to have slept once in his Life-time to be convinced of this. So that while some are disputing about the Manner in which the World exists, others absolutely deny that it exists at all ; but though I have slept more than once in my Life, I will not preach up a System to you, which would mutually annihilate you and me. I will rather assure you, that though we really should see the World in different Manners, yet I am willing, for my own Interest, to consult your Preservation. They will all agree in saying, that this Tree is so many Feet high, and the Leaves green, and that you are of a just Height and a fine Complexion ; and does not this Difference of Ideas diffuse an infinite Variety over the whole Face of Nature, who seems, even in the minutest Things, to take a Pleasure in diversifying herself a thousand Ways ? But what a Pleasure must you find in imagining yourself to appear to some under the Height of

of a Wax Baby, and to others as tall as the Image of *Flora* at *Farnese*. To some of an Azure Complexion, with the green Locks of a Nereid, and to others of a Vermilion Dye, and adorned with the rosy Tresses of *Aurora*, and under these different Aspects, to be agreeable to all, and adored under various Forms, as the Goddesses formerly were among the Ancients.

I must confess this Imagination, that every single Man sees the Face of the World, in a Manner different from all the rest, though (if you will have it so) it be a doubtful Point, gives me so much Pleasure, that I make no Scruple of carrying it beyond Size and Colours, to Taste, Smell, and all other Qualities.

I said, if you will have it so, only out of Complaisance to you; for if it be considered how very different the Nature of Things is, from what it appears to our Sight, since we reckon, for Instance, those Bodies smooth and solid, which are, in reality, full of Pores, Cavities, and Risings, and imagine them to be indued with Colour, Taste, and other Qualities which they have not, and which exist only in ourselves: When we consider too, that the same Bodies have

a different Appearance according to their Distance, and the other Circumstances in which they are seen ; when all this, I say, is well considered, I do not know whether we may not affirm, that every single Man sees them in a different Manner from all the rest, and that our Judgment is as much deceived in supposing that the same Things raise the same Ideas in different Persons, as it evidently is in the other Respect ; at least we may reasonably doubt whether it be not so. You may say, perhaps, that this is raising Doubts and Questions to hide our Ignorance ; but I must tell you, that it is one of the Duties of a Philosopher to search for Motives upon which he may form rational Doubts upon Things, or rather (such is our Misfortune) this is the best Part of Philosophy.

However, we every Day clearly see, that the same Objects do, in Effect, appear differently to different Persons. Not to say any thing of the more important Affairs of Morality, Law, and Politics, where what is esteemed in one Nation an Object of Veneration and Respect, is reckoned scandalous, and detestable in another. Did not the Ladies in one Age drive all the Colour out

of their Cheeks, and affect a pale languid Look, which were capable of inspiring the most lively Sentiments, at a Time when a painted Face would have been as shocking as a Fury? But in the next Age this very Fury becomes a *Venus*, and instead of Sighs and fine Speeches, the pale Beauties are recommended to the Care of a Physician, or the Use of *Spaniſh Wool*. Were not the very same Grashoppers, that weary us with their troubleſom Chirping, called by an ancient Poet the sweet Harbingers of the Summer?

There are whole Nations who esteem black Teeth a singular Beauty, and others who paint one Eye white, and the other red or yellow. In some other Countries a Beau scarifies and gashes his Face to appear more agreeable to the Eyes of a brutiſh Creature, who is alone the Miſtress of his Heart. An Olive Complexion on a Sugar-loaf Head, two little black Eyes ſunk in their Sockets, a flat Nose, and the Feet of a Baby, are Charms that make great Havock in the Hearts of the *Chineſe*, and occaſion whole Volumes of gallant Verses and Love E-piſtles. Our *Galatea's* and *Venus's* would not get ſo much as one *Billet-Deux*, or a

single Ode there, but would be looked upon as mere Caricatures.

In the same Country Learning is a Step to the highest Honours of State, and there is more Ceremony in making a Doctor there, than the *Polanders* use in electing a King. Are not Music and Dancing, which are with us (as anciently among the *Greeks*) an Exercise for Persons of the first Rank, looked upon in *Perſia* (as they formerly were at *Rome*) as scandalous Employments? And would not the same Ladies, who cause so many Commotions and Disturbances in Europe, be close confined in a *Seraglio*, and guarded by Eunuchs in the eastern Countries?

If you will not consent to admit a different Appearance of Things between Men, yet you must allow it to be so with regard to Nations (as for Instance, between us and the *Orientals*) unless you will except some particular Follies, which seem to have usurped a more extensive and universal Right over Mankind.

The ancient *Greeks*, the *Romans*, *Orientals*, and *Americans*, though separated from each other by such vast Tracts of Land, and so many Seas, yet all agreed in the ridiculous Notion, that when the Moon was in

an Eclipse (which is occasioned by the Shadow of the Earth, that deprives her of the Sun's Light) she was in hard and dangerous Travel, and imagined they could be of Service to her by Howling, rattling with their Timbrels, and making the most horrible Outcries and Noises they could possibly invent.

I find, said the Marchioness, you begin to grow a little more moderate after this philosophical Enthusiasm, which had carried you so far, that you endeavoured to reverse the whole Order of Things ; but you have now consented to grant, that we think alike in these Opinions which you call ridiculous. As to all the rest I am very well satisfied, if you place this Difference of Ideas at so great a Distance as is between us and the oriental Countries.

In order to make you still easier, answered I, we will at present place these different Ways of Conception at a Distance still greater, and in Proportion as you grow a greater Proficient in Philosophy, we will bring them gradually nearer to us, till at last we will agree to believe some Difference between your Ideas and mine, and from thence between the two Eyes of some Per-

sions to whom the same Object appears bigger when seen through one Eye, than it does when looked upon by the other.

How is this possible, said the Marchioness? There is no End to your visionary Fancies, and you seem resolved to put me to the utmost Proof of my Credulity. Not contented to make a Difference of Ideas between different Persons, you carry your Notions so far as to make this Difference between the two Eyes of the same Person. I must confess I think this a very daring Way of proceeding.

Did not *Gassendi*, answered I, one of the celebrated Philosophers of the last Age, affirm that he saw the Characters of a Book larger through one of his Eyes, than the other? Don't blame me, the Fault is in *Gassendi's* Eyes. You would find many other Persons with these faulty Eyes, if they were but as curious in examining their Senses, as they are diligent in making Use of them.

To some Persons an Object is said to appear *Green*, when looked at through one Eye, and *Yellow*, or *Blue*, when seen by the other. But do not we see every Day, that what one Person esteems cold, another calls hot?

hot? Or rather do not we ourselves think the same thing to be cold or hot according to our different Dispositions? Would not the very same thing that *Milo* would have thought smooth as a Mirror, appear rough as a Nettle to that luxurious Youth, whose Bed was strewed with Roses, and who could not sleep for a whole Night, because a single Leaf happened to be doubled?

And do not these different Sensations, which are so extremely opposite, as hot and cold, smooth and rough, proceed from a different Disposition of the sensitive Organs; from a different Affection of the Nerves, or the more or less delicate Texture of the Parts appointed to carry these Sensations to the Brain? And is it not therefore very probable, that these Differences may be in the Membrane of the Eye, upon which the Images of Objects are depicted, and in the Filaments of the Optic Nerve, which transmit these Images to the Brain? Hence it would follow, that as we receive different Sensations from the same Object of hot, cold, smooth, and rough, we should find the same Difference in our Sensations of Colours, and the like.

In order for me to enter into your Sentiments, said she, you must explain what you mean by saying, that the Images of Objects are depicted upon the Membrane of the Eye; and that the Optic Nerve transmits those Images to the Brain?

Do you know, answered I, that an Explication of this will be no less, than an Explication of Vision itself?

So much the better, said she. Indeed it seemed pretty strange to me, that after you had spoke so much upon the different Ways, in which it is possible for us to see, you should be silent upon the Manner in which we really do see.

I will not defer this Explication any longer, answered I, and I shall be extremely happy if my shewing you, in what Manner you see me, may induce you to look upon me in a different Way from what you have hitherto done.

Light is principally subjected to the two Accidents of Reflexion and Refraction. Reflexion, according to the *Cartesians*, happens when, by a Collision of the Globules of Light, with the solid Parts of Bodies, these Globules are repelled back again just as a Ball rebounds, when it is struck against the

the Earth. And it is by this reflected Light, that we see all Bodies, the Moon, the Planets, Heavens, and every Thing else, except the Sun, Stars, Fire, and all those other Bodies here below, which shine by their own Light.

Refraction is caused, when the Globules of Light, in passing through Air, Water, Glass, &c. meet with the Pores and Cavities of those Bodies; so that the Ray, which is only a Chain or Series of Globules, breaks and is turned out of it's proper Path, and takes a different Direction in it's Passage from what it had before. Pellucid, or transparent Bodies which suffer the Light to pass through them, such as Water, Air, Diamond and Glass, are called Mediums.

Hence Refraction is said to happen when the Light passes from one Medium to another; and this Refraction is greater or less, (that is, the Rays are more or less broken and turned aside from their Path) in Proportion to the different Densities of the Mediums through which the Light successively passes.

Thus for Example, the Rays are more broken in passing from Air into Glass, than in passing from Air to Water, because Glass

is much more dense than Water; and, for the same Reason, they will be more broken in passing from Air to Diamond.

If this was a proper Time, said the Marchioness, to make Criticisms upon Poets, it might be said, that *Tasso* has not expressed himself very accurately when speaking of *Armida*, he says,

As limpid Streams transmit the unbroken Ray, &c.

Poetry in these Verses does not seem to agree with Optics, which will not allow that a Ray can be transmitted unbroken.

Tasso perhaps, answered I smiling, would be understood to speak of those Rays, which fall perpendicularly upon Water or Crystal, that is, without being inclined (with Regard to the Surfaces of those Mediums) either to one Side or the other, as a Thread would fall upon the Ground if it had a Weight fastened to it: For in this Case, the Rays pass on without being broken, and continue to proceed in the same Path as they first set out in: But the Truth is, that Poets do not address themselves to Philosophers, nor to you who have your Mind now taken up with

with Refractions ; but they write for the People, and consequently, must often make use of vulgar Prejudices and Opinions ; and provided the Images be lively, the Passions strong, and the Numbers harmonious, we may pardon them a Mistake in Optics.

What do you think of *Ovid*, who has perhaps stretched the poetic Licence too far, and made the Sun in a Day run through all the Signs of the Zodiac ; whereas, according to the exact Rules of Astronomy, his diurnal Course is confined to about the thirtieth Part of only one Sign ?

In the second Book of the *Aeneis*, that Master-piece of sublime Poetry, there is a very fine Image, which, if examined by the Laws of Optics, would lose all it's Justness. *Aeneas*, after he had been assured by *Hector* in a Dream, of the irreparable Ruin of his Country, ascends a Turret, and there discovers the Treachery of the *Greeks*, whose dreadful Effects appeared from every Quarter. The Palace of *Deiphobus* already levelled to the Ground, his next Neighbour, *Ucalegon*, on Fire ; and the Flames of that City, which a ten Years Siege had attacked in vain, dreadfully reflected by the Waves of the Sea.

— The

— — — — The Seas are bright
With Splendour not their own, and shine
with *Trojan Light.* DRYDEN.

Now in the Situation in which *Aeneas* stood this could not possibly be; for the Opticians will tell you, that in order for him to see the Flames of the City shine upon the Sea, the Sea must have been placed between him and those Flames, which it was not. But who would not excuse this Error, which can be seen only by a very few, for the Sake of those fine Verses which all the World admires?

But to return again from Poetry to Natural Philosophy; a Transition you have made extremely familiar to me.

The Rays of Light, in their Passage through a rare Medium, into a dense one, as from Air into Glass, and in their Passage from a dense one into a rare, as through Glass into Air, undergo very different Modes of Refraction. I would be here understood to speak only of such Rays as fall obliquely upon the Mediums; for you already know that those, which fall perpendicularly upon them, suffer no Refraction at all. Suppose, for Example, that a Ray of Light falls through

through Air obliquely upon a Piece of Glass, from the Instant it touches the Surface, it will be changed, from it's Direction of a right Line, and form an Angle there, by receding farther from the Surface of the Glass, in it's Inclination, to a Perpendicular. We will suppose, if you please, that Bason, which stands before you, quite dry: So that a Ray, darting from your Eye, meeting no Interruption, strikes it's Bottom in the Centre: But as it is full of Water the Ray will be changed, from it's original Direction, in the Manner that has been before explained; and from the Moment it touches the Surface, tending more to a Perpendicular, reach some Part of the Bottom nearer to you than it's Centre.

These, Madam, are all the Lines and all the Figures which I shall trouble you with for the Explanation of this Phænomenon.

Why, what Necessity could there be for Lines and Figures, to make one understand that a Ray, in it's Passage from Air into Water or Glass, must necessarily deviate from it's right Direction? And by a Parity of reasoning, must not the contrary happen in the Passage of a Ray, from Glass into Air?

Without

Without Doubt, Madam, in that Case, the Direction of the Ray is still brought nearer to that Surface of the Air, which immediately touches that of the Crystal: So that it's Tendency is rather to get between them, as it were, by which, it is necessarily thrown off still more from the Perpendicular. The Ancients knew but little of these Deviations and Properties of Light; a more exact Knowledge of which has greatly contributed to the Perfection of *Astronomy*; from these arise a great many odd, and seemingly unaccountable Appearances, which amuse us every Day, as in seeing Objects through a Prism, where in Reality they are not: An Oar broken in the Water, and our seeing ourselves crooked in the Bath.

The very Thing, cried the Marchioness, that happened to me the other Day, and I could not help being anxious about the Cause of it.

The Cause, Madam, is nothing more than the Refraction, which Rays of Light undergo, in passing from Water into Air: It would be a most agreeable Entertainment to shew you all the whimsical Effects of it upon the Margin of your Bath. Optics make us very curious.

That

That kind of Curiosity, said she, should be confined to Optics only; but however that may be, it would still be greater Curiosity to see how far that Phænomenon, which I indiscreetly interrupted, agrees with the Present.

It is to these Deviations and Refractions of the Rays of Light, (tho' the Transition be by no ways agreeable, from so charming an Episode, to the present Subject) that we owe these several Appearances: That of Water in Basins, and a River's appearing deeper than it really is; our seeing at Sea beyond the Reach of common View: From hence 'tis too, that Mariners, after the Fatigue of a long Voyage, are sooner blessed with the Sight of the wished for Shore: Hence too the Sun and the full Moon, when near the Horizon, in Appearance, change their real Figure for that of an Oval. These, and all other Phænomena of this Kind, proceed from the same Cause, *viz.* That as the Rays, proceeding from them, undergo the Refraction which has been already explained to you, we see them in Places where they really are not; but the Eye, not in the Secret of Refraction, always sees the Object in that Direction, in which the Rays

after

after their Deflexion strike it: So that not only the Situation of the Object is changed, but their Figure too. Had I looked through a Prism the first Time I had the Honour of seeing you, which refracted the Rays to such a Degree, as to strike my Eye, in the same Direction that they would come from Heaven, in that Case, unacquainted with Optics, I should have thought you placed there, surrounded with a vast Variety of Colours, and, like *Endimion*, to the Moon, should have addressed myself to you to descend; and by some florid Description, of a solitary Bower, or shady Valley, invited you to quit your starry Seat: And all this would have risen from the Direction which the Prism would have given to the Rays which came from you to my Eyes.

I fancy, said the Marchioness, that Mankind always look upon those, who are in a Condition much superior to their own, through certain Prisms, which make them appear as if they were transported to Heaven, to revel upon Ambrosia; enjoy the Conversation of the Gods, and be surrounded with Glory and Happiness: Whereas, the more they are elevated above others upon

upon Earth, the more subject are they to the Sport and Caprice of Fortune.

This Comparison will appear still juster, answered I, upon this Account, that as when we quit the Prism, we see the Objects again return to their proper Place: So when we forsake the Prejudices of the Vulgar, and substitute those of good Sense in their Room, these Demi-Gods appear nothing more than other Men, and in a Condition not greatly to be envied.

But to return to our Subject. A philosophical Eye every Day discovers an infinite Number of strange and diverting Phænomena arising from the Change of Direction, produced in the Rays of Light, not only by Refractions, but by Reflexion too: From hence proceed all the Wonders of concave Glasses, by the Help of which, that Poet, who wrote a Dissertation on the Nature of Bees, could discern the small Members and diminutive Parts of that noble and industrious Insect, and magnified them to that Degree that

—Objects their nat'ral Size so far surpass
That Bees seem Dragons in the magic
Glaſs.

With

With these Glasses too, the Vestals re-kindled their sacred Fire whenever it happened to be extinguished: From hence arose the Fables of *Archimedes* and *Proclus*; and Ignorance and Imposture have rendered these Glasses one of the favourite Instruments of Magic. But amongst all the Phænomena arising from the Reflexion of Light, you will be perhaps surprised to find that there is one, which tho' extremely curious in itself, yet presents itself to you every Day unnoticed.

What can this unfortunate Phænomenon be?

'Tis, Madam, the Representation of yourself, which appears beyond your Looking-Glass, while you consult the Graces to throw your Hair into the most becoming Disorder: In that Case, the Rays of Light, proceeding from your Face, reflect from the Looking-Glass to your Eyes, exactly preserving their Distances from each other; and so appear as far beyond the Glass as you are from it: And from the Pleasure this beauteous Representation affords you, you easily conceive what Pleasure the Original must give to others. The celebrated *Milton*, has, in his sublime Poem, finely described the

light

light and Surprise of *Eve* the first Time she surveyed herself in a Fountain

— That stood unmov'd
Pure as the Expanse of Heaven.

And this Image of herself appeared so charming, that, like another *Narcissus*, she afterwards ingenuously confessed to *Adam*, that tho' she thought him fair, yet he seemed

— Less fair,
Less winning, soft, less amiably mild,
Than that smooth wat'ry Image—

Does not this Passage of *Milton* convey some malicious Insinuation, said the Marchioness? And is not his real Meaning, that the Sight of a Husband gives a Woman less Pleasure, than even an Image or a Shadow? However, I agree that our first Parent was in the Right to admire this fine Phænomenon; and I have been greatly to blame in my Neglect of it; but we are too early accustomed to the Sight of these Things, for them to make a strong Impression upon us.

If

If any one had told me, a few Days ago, that certain Rays, flowing from my Face, would have been reflected from the Looking-Glass, I should have believed it to be one of those usual Enigma's which Gallantry borrows from Tradition, or founded upon the Authority of some old Romance: But I confess, that from this Time I shall survey myself in the Glass with a sort of philosophical Pleasure.

Amongst the Amusements of Philosophers, there is none greater, Madam, than that of observing the various Play of the Rays, in their Passage through a Convex Glass: A Glass, whose Surface is swelled on either Side, and resembling a Lentile, is for that Reason called a Lens. Suppose two Rays exactly parallel to each other, that is to say, which in all given Parts preserve an equal Distance from each other, in the same Order; for Example, that these Es-paliers stand, without receeding from, or approaching each other. These two Rays falling upon a Lens, and being refracted, unite in a Point beyond it, called the Focus of the Lens; this Point appears more or less distant, in Proportion to the Convexity of the Glass: If it be but little, the Focus

is at a greater Distance: If more convex, it is nearer to it. In these several Degrees of Distances, we pronounce the Qualities of a Glass, as 'tis of such or such a Focus, according as the Point is distant from it: As in describing the Power of an Engine, you say, it will raise Water to such or such a Height.

I should imagine, says the Marchioness, that you call it the Focus; because in that Point we may light a Candle, which I see lately done with one of those Glasses, seemingly without Fire.

They might have gone still farther, replied I, and lighted it with Ice, for a Lens of Ice will have the same Effect as a Glass one for a short while. How many Imper-
tinencies might this have furnished the Poets with in that time when their Language was?

See, guarded by the watchful Powers of
Love,
Fair *Delia* slumbers in the peaceful Grove;
Struck with the Sight, let wond'ring Mor-
tals own
Amidst the gloomy Shades, a radiant
Sun.

But

But the Reason that you give is a very good one. The Burning which follows in that Point where the Lens unites the Rays which were at first parallel, and forms them into a Flame, is the very Reason why it is called the Focus.

A Number of Rays not coming in parallel Direction, but diverging from each other, will unite in a Point beyond the Focus. Hence 'tis, that a Lens is said to make both parallel and diverging Rays converge. We call such converging which proceed from different Points in a Tendency, to approach each other and meet: Thus the Walks of a Grove planted Star-wise gradually approaching each other, meet at last in a common Centre. The Image strikes, Sir, but yet I believe those very Walks to a Person, placed in the Centre, will appear diverging, as in the Continuance of their Direction, they gradually re-cede from each other.

You want nothing, Madam, replied I, but to turn over *Euclid* and *Apollonius* a little, to put on now and then an abstracted Look, and you will be a complete Geometrician. But to pursue our Rays, the greater the Distance of the Body, when they come from

from the Glass, the nearer the Focus; and so on the contrary, the nearer the Body to the Glass, the more distant the Focus; provided, however, that the Point, from whence these Rays proceed, be not at such a Distance, that instead of uniting they are thrown out of the Glass either diverging or parallel.

Opticians, in order to find out the infinite Play of these Rays, make use of a certain Science called *Algebra*, which has extended it's Dominion over all *Natural Philosophy*, and has been applied by the Ingenuity of Interest to civil Uses, and to illustrate the Doctrine of Chances, in such Games as most depend upon the Caprice of Fortune. It has even insinuated itself into the litigious Worlds of Law and Morality. They are always provided with certain Letters connected together, with certain Signs which they call Symbols: With these, provided they do but know the Qualities of the Lens, that is to say, the Length of it's Focus, and the Distance from whence the Rays come, or the Distance of the Point, in which such Rays unite, as fall converging on the Lens, can instantly tell you, whether they will unite or no; whether

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they will pass through the Lens parallel or diverging, or in what Point they will unite, and all this with a certain Kind of Magic, that would scarcely have passed unpunished in those Days when it was criminal to assert the Motion of the Earth, or the Existence of the Antipodes.

The Uniting of the Rays, diverging from several Points, into the like Number of Points beyond the Lens, which seems in itself a very indifferent Thing, supplies us with one of the finest Sights you can possibly imagine: If to a Hole made in the Window-shutter of a darkned Room, you apply a Lens, and over-against this, at a proper Distance, there be placed a Sheet of white Paper, you will see all the Objects which are without the Window (especially those which are directly opposite to the Lens) inverted and painted upon the Paper with a Beauty, Vivacity, and Softness of Colours, that would make a Landskip, drawn by *Claude Lorrain*, or a Visto by *Canal-leto*, appear faint and languid. You will distinguish the exact Distance of Objects by the Difference of their Size, and the Confusion in which those that are farthest off must always appear, and from a gradual Faintness

Faintness of Colouring; in short, from a most exact Perspective, the grand Secret of that happy Art of Delusion, Painting.

It is impossible to express to you the Pleasure that results from the Motion and Life which animate this fine Piece. The Trees are really agitated by the Wind, and their Shadow follows the Motion. The Flocks bound upon the Lawns; the Shepherd really walks; the Vessel spreads its Sails along the Piece; and the Sun-beams play upon the Waters: Nature draws her own Picture inverted and in Miniature.

It is pity, said the Marchioness, that so fine a Picture, drawn by the Hand of so excellent a Master, should be turned upside down, which I am as much at a Loss to find the Reason of, as I am of the Manner in which it is formed.

Let us suppose, answered I, without-side of the Window, over-against the Lens, an Arrow to be placed horizontally, that is, even with the Bottom of the Window: Let the Point of this Arrow be on the Right-hand, and the Feathers on the Left. Suppose too, that the Extremity of the Point emits Rays upon the Lens, which intirely cover it. These Rays unite beyond the

Lens itself in another Point, but in passing through the Lens, instead of being on the Right-hand, as they were at first (as proceeding from the Point of the Arrow, which we supposed to be on the Right-hand) they change their Situation, and are placed on the Left. In the same Manner, the extreme Point of the Feathers throws Rays upon the Lens, which unite in another Point, and after their Passage through the Lens, are turned from the Left to the Right-hand. Just in the same Manner as if a Person held two Sticks, one in each Hand, and should cross them together; that which, before the crossing, was on the Right, will afterwards be on the Left-hand, and on the contrary, that, which was on the Left, will be on the Right. Now the Rays that fall upon the Lens cross each other, just as these two Sticks do in the Point where they touch. The same may be said, if the Arrow should be set upright. Those Rays, which proceed from the Top of it, after being crossed, and passing through the Lens, remain at Bottom, and those which came from the Bottom, at Top. Thus you see the whole Situation of the Rays is changed: That which was at

at Top, is placed at Bottom, and what was at Bottom, appears at Top: That on the Right-hand is turned to the Left, and that on the Left to the Right. If a Sheet of Paper be then placed behind the Lens, in the Place where these Rays unite, they will draw you an Image of the Arrow, in which the Point shall be on the Left-hand, and the Feathers on the Right; or, in other Words, the Image of the Object will be inverted.

You may easily transfer what I have said of the Arrow to a Landskip, a Piazza, or any other Object, with this Difference however, that all the Parts of a Landskip or Piazza cannot be equally distinct in the Picture as those of the Arrow are, because the Rays unite at different Distances of the Points, from whence they flow. If, for Instance, an Object in the Middle of this Walk is seen distinctly upon the Picture, as it will be if the Paper be set in that Spot, where the Rays which come from it unite; Objects which are nearer cannot be distinct, because the Point where their Rays unite is at a greater Distance. Neither will Objects, which are farther off, be distinct, because the Point, where their Rays unite,

is nearer the Lens, and consequently the Rays, as well of the one as the other, fall upon the Paper disjoined, and only form an Image there, which will be very dim and languid, or, in other Words, confused; so that for those Objects, which are far off, we must place the Paper nearer the Lens, and set it at a greater Distance when we would see those which are near.

Pray then, said the Marchioness, provide yourself with a Lens, and give me a Sight of these fine Landskips all round us upon a Sheet of Paper. For I must confess I have a great Curiosity for this, both as a Woman, and as a Woman whom you have rendered half a Philosopher.

I wish, answered I, that I had one with me to satisfy your Curiosity this Moment, which by what you say must be extremely strong; but I will satisfy you, as soon as I am able, with a View of this *Camera Obscura*, the rather because I don't think a dark Room the most improper Place to entertain a Lady. But what will you imagine, if I desire you, when we are there, to suppose yourself placed in one of your own Eyes, and that you see every thing that passes in it.

The

The *Camera Obscura* represents the Inside of our Eye, which is nearly of the Shape of a Ball: The Hole in the Window is the Pupil which is in the Fore-part of the Eye, and appears in all as a dark Hole sometimes greater, sometimes less. The Lens is the crystalline Humour, which is exactly of that Figure, and is placed over-against the Pupil, and suspended by certain little Fibres called the Ciliar Processes, which proceeding from a Coat, or very thin Skin, which incompasses the Inside of the Eye, are fixed in the Edge of it: The Paper on which the Image of Objects is depicted, is the Retina composed of the Filaments and medullary Substance of the optic Nerve, which is fastned to the Eye behind, and is the great Channel of Communication between that and the Brain. The Spaces which are between the Fore-part of the Eye and the crystalline Humour, and between this and the Retina, are filled with two Humours less dense than the Crystalline, but denser than the Air. By the Help of all this Apparatus, external Objects are pictured upon the Retina in Miniature, just as in the *Camera Obscura*, and thus we see.

Really I did not think, said the Marchioness, that I should be transported thus in an Instant, from the *Camera obscura*, to the Inside of my own Eye; nor that the fine Picture, you before described, had so much Relation to Vision.

Many must have observed this, answered I, before you, without suspecting any such Relation. If there be a Hole made in any Room, which is otherwise dark; and this Hole does not exceed a certain Bigness, this will be sufficient to shew you those Objects which are over-against the Hole, painted upon the opposite Wall, or the Floor of the Chamber.

Is there no Need of the Lens then, said the Marchioness, in order to the Production of this Picture?

It is necessary, answered I, to give it, in some Measure, the finishing Stroke. But even without the Lens, if the Hole be small enough, and the opposite Wall or the Floor not very distant, the Rays which pass through the Hole are near enough not to appear confused, and may draw a tolerable Picture of the external Objects upon the Wall or the Floor.

If

If the crystalline Humour becomes opaque, which is what forms a Cataract, there is no other Remedy in this Case to recover the Sight, than by depressing the crystalline Humour and cutting the Filaments, which hold it suspended, and then some faint Representation of the Objects may be drawn on the Retina of those unhappy Persons. But as the Picture in the dark Room, is much weaker and more confused, if there be not a Lens applied to the Hole; so is that which is made upon the Retina of these Persons, when the crystalline Humour, which is the Lens of the Eye, is no longer fixed over-against the Pupil. It is true those two Humours which remain (the glassy and aqueous) help the Rays to unite, and a convex Glass may, in some Measure, supply the Defect of the crystalline Humour.

It would be well if this convex Glass could also assist the Eyes, under a much more grievous Misfortune; in which, tho' they seem well and sound, the Retina, or the optic Nerve, being weakened and obstructed, cannot transmit any Sensation to the Brain, of the Images of Objects, though they are clearly and distinctly drawn upon it.

This Distemper, which is called a *Gutta*

serena, occasioned the Blindness, if not of the Greek, at least of the British Homer, which he interweaves in his Poem, among the Beauties of *Paradise Lost*, the Battles of Angels, and the pregnant Abyss.

This Picture then, of the *Camera Obscura*, said the Marchioness, which seemed of no other Use than to employ idle People, or such as have a Taste for Painting, is, in Reality, of very great Service to us; and in some Cases, even restores Sight to the Blind. Are we not obliged to *Des Cartes* for having rendered it so useful to us?

Des Cartes, answered I, is very happy, to whom you would willingly be obliged for every Thing. But in this Case your Acknowledgments are due to an industrious German, who laid the Foundation of many Things which others have since brought to Perfection. He was the first who gave us a true Explication of Vision, which has always been a Subject of Speculation among Philosophers; and, consequently, has had it's Share of ridiculous Notions: For some among the Ancients supposed certain Rays, which extending themselves from the Inside of the Eye, to its Superficies, pressed the Air as far as the Object to be seen, and this

Air, finding some Resistance from the Object, made it perceptible to the Sight. Others affirmed, that Vision was formed by the Reflexion of the Sight; that is, because Rays flowed from the Eye to the Object, and were from thence reflected back to the Eye: So that these gave it an exact Information what the Object was.

Nor were there wanting some, who affirmed, that certain Effluvia go from the Eye, and meeting in their Way with other Effluvia of Bodies they link themselves with these, and turning back again with them to the Eye, give the Soul a Perception of Objects: And the most rational among them asserted, that extremely fine Membranes, formed of Particles and Atoms, are thrown off from the Surfaces of Bodies, and have mutually the same Disposition and Order, as there is in the Surfaces of the Bodies themselves, from whence they proceed; and that these Membranes, which they call Simulacra or Images, exactly resembling the Bodies from whence they are sent, enter into the Eye; and this is the Cause of our seeing: And it is surprising to think that in the present Age, and much more in such a Country as *England*, there should be found any Person,

who * shutting his Eyes against the Light of Things, should again try to plunge us in the profound Darkness of unintelligible Jargon ; asserting, that Vision is formed by different Degrees of expansive Force in Bodies, communicated through a Plenum, to our Eye ; and that the different Modifications of Vision, such as Clearness, Weakness, and Confusion, arise from the Proportion of those expansive Forces with the contractive Forces of the optic Nerves. However, all the Moderns, (except this *Englishman*, who perhaps was ordained like him that wrote of late Days against the Circulation of the Blood, to give us a Specimen of the infinite Extravagancies of the human Mind) have rejected these chimerical Explanations, the Offspring of Pride and Ignorance :

* Doctor *Robert Green*, Fellow of *Clare-Hall, Cambridge*, published in 1712, a Book intitled, *The Principles of Natural Philosophy* ; in which is shewn, the Insufficiency of the present Systems to give us any just Account of that Science, and the Necessity there is of some new Principles, in order to furnish us with a true and real Knowledge of Nature.

The celebrated Mr. *Cotes*, Professor of Astronomy, used to say, that this Book shewed the Author to have had as extraordinary a Genius as Sir *Isaac Newton's* ; since it must have been the Effect of Design, to guard so effectually, as he did, against saying any one right Thing throughout so large a Treatise.

norance: Neither have they greatly esteemed the Reasonings of those who thought that the Effluvia proceeded rather from the Eye, than from the Objects; as it seemed more reasonable they should proceed from an animate, than an inanimate Substance; that the Ears, the Mouth, and the Nose, were made concave to take these Effluvia in; whereas the Eye was made convex to send them out.

Notwithstanding all these fine Reasons, Opticians have reduced the Eye to a perfect *Camera Obscura*, rejecting and extinguishing that Light, which the greatest Part of the Ancients supposed to proceed from it. Indeed the august Eyes of *Tiberius* must perhaps be excepted; who, as 'tis said, when he waked in the Night, could for some time see as well as in clear Day-light, which is said to arise from his emitting certain Sparks from them. You may say the same of any other Person, who is considerable enough to deserve that an Exception should be made in his Favour.

It will be necessary for us, said the Marchioness, to look upon Cats as considerable Persons, and make an Exception in their Favour too.

We

We shall willingly grant them that Honour, answered I, only they must not take it ill if we say that the Light, which seems to proceed from their Eyes in the Dark, serves only to give Light to Objects ; and by this Means, the Image may be drawn upon their Retina : For Vision, as well as innumerable other Things, is performed in the same Manner in Men as in Brutes ; or rather, we may acknowledge ourselves obliged to them for that Evidence, which we have of the Manner of it's Operation ; since in order to demonstrate it we make use of the Eye of an Ox, or some other Animal, at the Bottom of which, when the Coats are taken away, if we place a very thin and transparent Paper, we shall see the Image of those Objects, to which the Eye is turned, drawn upon it and inverted, just the same as in a *Camera Obscura*. This shews how very capricious our Senses are : For Instance, we usually say, that there is Heat in the Fire : We say, there is Heat in our Hands. Thus we confound one Motion, which is in the Fire, and another which it raises in our Hands, with the Sensation of Heat ; which Sensation is neither in the former nor latter : But we do not

not say that Colour is in our Eye, as it is in Objects; though, without Dispute, the Colours raise some Vibration and Motion upon the Retina, and are painted upon it as strong and lively as they are upon the Objects themselves. Thus we confound two Things in the Perception of Heat, and only one in that of Colours.

It appears, said the Marchioness, that we are much obliged to our Senses in this Point, for exempting us from one Illusion at least. But do not they amply repay themselves by those many others, to which they have subjected our Sight? We see only one Object though it be looked at with both Eyes, and see it upright, though it be drawn inverted upon the Eye.

You are a little too much prejudiced against the Senses, answered I, and I must, for this Time, undertake their Defence. Is not the Reason of all this Violence, which you express against our Explanation of Vision, because you had it not from *Des Cartes*?

Defend it if you please, said she, without accusing me, and rescue it if you can from the Charge of these two Illusions which I alledge against it.

Would

Would they not rather be Illusions, answered I, if we were to see an Object double which we know to be single; and that to be inverted, which we know to be direct? To-morrow we will enter upon a Discussion of these two Points, which *Huygens*, one of the great Promoters of Knowledge in the last Age, thought beyond the Reach of human Understanding.

To-morrow, perhaps, you may know more than that great Man; but it is impossible for that Acquisition to render you more charming than you are To-day.





ENTERTAINMENT III.

Several Particulars of Vision. Discoveries in Optics. A Confutatinn of the Cartesian System.

HE Marchioness burned with Impatience to become more learned than *Huygens*. She proposed not to lose Time, that I should proceed in the Explanation of Vision. The very next Morning, as soon as we had left our Chambers, I told her that some more ceremonious Preparation was requisite to so exalted a Science, and that this sublime Subject well deserved some Hours Contemplation; at least, till after Dinner, she might make Use of the intermediate Time in finding the Cause why the Eye, though it sees all external Objects, has no Faculty of seeing itself; and this would better enable her to understand the Compliment

ment in these Lines, which, no doubt, had been often addressed to her.

Ah, lovely Eyes ! your dazzling Beams
Could you but inward turn,
You then might know how fierce those
Flames

In which I hopeless burn ;
But Nature, while she all the rest reveal'd,
Her brightest Work alone from you conceal'd.

Into my Eyes then dart your Rays ;
But, ah ! benignly dart !
There is true Mirrour Love displays,
There may you read my Heart :
There in Reflection you yourselves may
see
Two Stars that influence my Destiny.

This was all the Optics she could get from me in the Morning, which made her long for the Afternoon with the Eagerness of a Novice, who hopes to be admitted into some profound and important Mysteries— At last, how should you like to be told, Madam, began I, that as Objects appear only single to your two Eyes, you in reality

lity see but with one, while the other is inactive and at rest.

Oh! we had better once for all, said she, fairly put out one of our Eyes, and then there remains no further Difficulty. You may just as well say that we walk only with one Leg.

I find, Madam, you are not so extravagant, replied I, as a *Latin* Poet represents Women, who, he says, could be better content with one Eye, than with one Lover — But the Solution, which I just now mentioned, was given by a very grave Philosopher, and is so absurd, that it puts me in Mind of the Presumption of the *Chinese*, who vainly imagine that they are the only People who see with both Eyes, while the rest of the World is confined to the Use of one — However this may serve to let you see what Difficulties there are in solving the Question we are now upon.

Another made the optic Nerves to resemble two Lutes, whose Strings have a mutual Correspondence so that the two Images of the Object falling upon Strings wound up to an equal Height or a Unison, the Object must appear single; but all these fine and ingenious Explications will not make

you

you a better Philosopher than *Huygens*. I believe that the true Explanation of this Phænomenon, like many others in Vision, depends upon Experiments. The Senses of Feeling and Sight lend each other a mutual Assistance in the Formation of our Ideas, just as our Eyes and Ears help each other when we learn a new Language. The Sense of Feeling, which is much stronger than that of Sight, has constantly informed us, that in the ordinary Way of Seeing, the Object is but single, and by a long Habitude we join the Idea of one single Object with these two Sensations of it.

In the same Manner an Object that is felt with two Hands or two Fingers at a time, notwithstanding the two Sensations which we have of it, seems to be single, and this occasioned by those Ideas which we had conceived of it, when we touched it only with one Hand or one Finger; if a Button or a Ball of Wax be pressed with two Fingers at a time, in an unusual Manner, by crossing the Fingers together it will appear double, just as Objects do when we squint upon them. In both Cases the antecedent Idea of Feeling are not so strongly united by a long Habitude with these unusual Sensations

as

as to make us join them with the Idea of one single Object.

Do you believe then, said the Marchioness, with an Air of Surprize, that if a Person had been long accustomed to press a Button with two Fingers crossed together, he would no longer feel it double?

No, certainly, answered I, for the very same Reason that Objects do not appear double to Persons, who are naturally squint-eyed. These, by a long Use, acquire the same Habit in their Manner of seeing as we do in ours.

We have a very singular and curious Observation, to this Purpose, upon a Person, who, by some Misfortune, had distorted and dislocated one of his Eyes. At first all Objects appeared double to him, till, at length, by little and little, those, which were the most familiar to him (that is, those which he had the most Experience of by feeling) became single, and in time all the rest, though the Dislocation still continued. I may venture to affirm, that, by Virtue of this Experience, *Argos*, with all his hundred Eyes, did not see the fine Heifer committed to his Charge, by the jealous

Juno, a whit more multiplied than *Poliphemus* did his *Galatea* with only one Eye.

You seem to exult mightily, said the Marchioness, in this Experience which we gain from our Touch; will it give you Confidence enough to undertake by it's Assistance the Solution of that Question I proposed to you Yesterday; how it comes to pass, that Objects, which are drawn inverted upon the Eye, appear direct upon the Mind?

These Experiments of the Touch, answered I, extend farther than you perhaps imagine, and the Ideas of Sight, considered with Regard to those which we receive from Touch, are no more than four Strokes of a Pen, compared to a fine Relievo. We have the Example of a Statuary, who, though he was blind, yet, by the Help of his Feeling, cut tolerably good Likenesses. And you may believe, Madam, to complete a female Bust, he copied the Breast as well as the Head.

In *England*, that Country of Phænomena, one of the most famous Mathematicians, and one much better qualified to explain Optics to you than I am, was deprived of his Sight so young, that I may almost say he was born blind. This was a more extraordinary

dinary Person than the great *French* Genius, who undertook to learn Music without either Voice or Ear, yet penetrated the most secret Mysteries of the Art, and arrived to it's most delicate Perfection. This great Philosopher receives from his Touch more distinct and clear Ideas than Sight conveys to others. How would it add to his Pleasure if he had the exquisite Sensation of your taper Fingers to feel the converging and diverging of Rays!

On the other Hand, what could we learn, or what could we do without Feeling?

We should be incapable to judge of the Situation, Distance, or Form of Objects, as *Berkley* has prophesied, who perhaps, considered the Metaphysics of Vision more than any one ever did: And Experience has verified this in some Persons, who after being cured of Cataracts, born with them, could not form any Judgment 'till the Touch lent them it's Assistance: Without this, our Eyes would continually tantalize us with a View of Knowledge and Pleasure which we could never enjoy.

Our Condition would be then more lamentable than that of the wretched Guardians of the *Seraglio*: The daily Experiments then,
that

that we make with our Feeling informs them, that Objects are direct, (in the same Manner as they teach us they are single) that they are placed in certain Situations, at certain Distances, and of certain Figures.

I believe *Des Cartes* is the only one who ever pretended to give an immediate Explication of this difficult Phænomenon by a Similitude. Suppose yourself, said he, to hold two Sticks across each other, one in your Right, and the other in the Left-Hand; and to walk with your Eyes shut, about a Room, with these Sticks before you, there is no Question but you will think those Things which you touch with the Stick in your Right-Hand; and by this Means will make a Pressure upon that Right-Hand to be on your Left: And, in like manner, whatever you touch with the other Stick in your Left-Hand, you will affirm to be on the Right.

After the same Manner, the Rays which proceed from Objects to the Bottom of the Eye, crossing each other in the crystalline Humour, those which press the Retina on the right Side, will make you refer those Points, from whence they proceed, to the left Side; and those which press it on the

Left

Left you will refer to the Right Side; and thus those Rays, which press upon the upper Parts of the Retina, will make you refer the Points, from whence they proceed, to the lower Part; and those of the lower to the upper: And by this Means, the Image, which is inverted upon the Retina, makes you see the Objects direct.

Indeed, said the Marchioness, this is a very ingenious Explanation. Why may we not confine ourselves to this, which gives us so immediate a Reason for the Phænomenon without going any further?

Experience, answered I, unhappily informs us, that this one is not so very ingenious: A Boy, who stands upon his Head, sees every Thing inverted, notwithstanding the Images of external Objects are pictured upon his Retina, in the very same Manner when he is in this Situation, as they are when he stands upon his Feet: He has no other Idea of high and low than what regards his own Situation; and when he is in this inverted Position, he imagines the whole Universe to be so too. Besides, the Explication of *Des Cartes* supposes the Ideas of High and Low, Right and Left, which we can only have from feeling, to be antecedent to those of Sight.

It is our Feeling, which, by an Experiment every Moment repeated, has constantly taught us to call the Earth (towards which we find ourselves continually carried by Gravity) *low*: To call those Things which are contiguous to the Earth, as the Pedestal of a Pillar, or our Feet, *below*; and those Things which are distant from the Earth, as our Head or the Top of a Tree, *above*. The Sense of Feeling conveys these, and the like Ideas, into the Soul of a Man, born blind, with as much Exactness as that of Sight does the Ideas of Colour into ours.

Now, if we suppose that Vail that hides the visible World from his Sight to be taken away all at once, and consider in what Manner he would judge of the Situation of Objects, we might from thence arrive to a clear Knowledge of the Manner in which we ourselves judge of them, since we have the Ideas of *high* and *low* in common with him; he would certainly be more surprised at first opening his Eyes than the famous *Epimenides** was, after his long Sleep of so many Years,

* *Epimenides*, a Cretan Philosopher, when he was a Boy, being sent by his Father, into the Country to fetch a Sheep, he turned out of the Road, at Noon, and

Years, who remembred nothing which he saw about him when he waked, not even the Place where he had been born and brought up. A new Scene of Ideas displays itself unto him ; a Torrent of new Perceptions rush upon him through this new Avenue by which Objects enter the Soul : Amazed and over-whelmed with them, he finds himself transported, without knowing how, into another World.

What a Pleasure, what an Extasy must this be ! said the Marchioness : If Novelty, which always hovers about these Things, of which we have an Idea, and is nothing more than an unusual Combination of those Objects we are already acquainted with, affords so much Delight, what an infinitely greater Pleasure must this Man have in a World of

and repos'd himself in a Cave, where he slept 57 Years. After this Refreshment, he awaked and looked about for the Sheep (imagining he had slept but a little while) not finding it, he proceeded to his Father's Country Estate, where he saw every Thing altered, and in Possession of another. He then returned to the City and went to his Father's House, where his younger Brother, now grown an old Man, at last knew him, and gave him an Account of all that had happened. He was held in great Veneration among the Greeks, who imagined him a peculiar Favourite of Heaven. He is said to have lived 'till 150 Years old, or according to others 297.

Things really new, and a new Combination of those Ideas which he before had joined to those with which the Addition of another Sense abundantly supplies him ?

But as human Happiness is too often attended with some Alloy, is it not possible for him to see something that would make him wish his Eyes shut again when they were hardly open ? He would have great Reason to believe that those Objects would appear pleasing to this new Sense, which had been so to the rest, and flatter these as agreeably as they had done those. But might not the Event happen quite contrary to his Expectation ? And those Objects, which had delighted his Touch and Hearing, prove very disagreeable to his Sight ? So that instead of encreasing the Number of his Pleasures, this new Sense would deprive him of the most sensible of them ; and perhaps, cruelly dissolve some pleasing Tie which the others had closely bound.

It is a melancholy Truth, replied I, that these Senfes frequently differ in their Representations of Objects ; and many People daily find, that when they cease to judge by Imagination alone, there is very little Connexion between the external Appearance

of

of Things and their Reality ; so that they arrive too soon at the Possession of what they thought they could never make too much Haste to attain.

A blind Man, answered she, at least while he is in Love, should never desire to see ; satisfied in the Judgment of those Senses, which represent an Object agreeable to him, why should he ask that of another which, perhaps, would at once condemn his Choice ; and, like Reason, probably make him see his Misfortune, without giving him any Assistance to avoid it ?

'Twere the only Consideration, returned I, for this seeing Wretch that he would not be unhappy so soon as you imagine.

Said she, If the Joy of receiving his Sight did not entirely deprive him of all Complaisance, would not the very first Thing he desired to see, be that Person, for whose Sake he principally wished for the use of his Eyes ; and when he had seen her, he would immediately, if she should appear disagreeable, perceive his Unhappiness, if, with regard to Beauty, Love did not render him a second time quite blind ?

He would enquire for her, answered I, would he see her, and yet by that Means

would not know her again : This would be a Miracle even beyond the Power of Love to effect ; he would hear if you will the Sound of those Words, pleasing to his Ear, and still more pleasing to his Heart ; but he would not know the Mouth from whence they proceeded ; and, would you believe it, he would be so far from distinguishing another, that he would not distinguish himself, his own Feet, or Hands, from any Assistance his new Sight could give him ; since he must be utterly ignorant of the Connexion which the Perceptions of Sight have with those of Touch ; yet this Connexion is absolutely necessary in order for his knowing those Objects again, of which he had no Idea but what he received from the Senses of a Nature, very different from that of Sight ; and depends upon an Experiment which has never yet been made. His own Hands would be the first Object he would learn to distinguish, by looking upon them at the same Time, and remembering that such an Idea of his Feeling would agree with such another of his Sight : When he had learned this short Lesson, Love would more easily conduct him to those Experiments that would soon, either to his Joy or Sorrow, satisfy

satisfy his amorous Curiosity: And we will conduct him to those that may content ours, which is of a more philosophical Nature.

One of the first he would try, would be to lift up that Hand which he has now no Trouble to distinguish; and in doing this, he would perceive some Change in Sensation, which he received of it from his Sight: And the Reason of this Change is, because the Image changes it's Situation in the Retina, in Proportion as the Hand is higher or lower. Guided by Nature herself, he would diligently observe what Sort of Sensation he felt when he held his Hand up; and whenever he felt the same Sensation raised in him, either by the same, or any other Objects, whose Image would fall in the same Situation of the Retina, though unknown to him, he would conclude that Object to be high, or in that Situation in which his Hand at first was.

By this Means, connecting the old Ideas of Feeling, with the new ones of Sight, he judges of the Height or Lowness of the Object; of it's being direct or inverted: And it is of no Importance whether the Image of this Object be pictured upon the

Retina, direct or inverted, or in any other Position.

External Objects are signified to him (if I may use that Expression) by certain Sensations of *Light* and *Colours*, as the Thoughts of the Soul are to us, by certain Characters, not by Virtue of any Resemblance between the one and the other, but by Means of an arbitrary, yet constant and perpetual Connexion which we haye observed between them: And as when we are accustomed to any particular manner of writing, it makes no Change in the Order of Ideas, which these Characters excite in us, whether they are written from Left to Right, as ours are; from Right to Left, like the *Oriental*; or from Top to Bottom, after the *Chinese* Manner: So whether Images be drawn direct or inverted upon the Retina, it does not at all change our Judgment of their Situation.

The blind Person, who has hitherto safely conducted us through this Labyrinth, resembles each of us: We enter into Light with our Eyes shut, and probably do not begin to see 'till we have some Time felt: Thus, Madam, you are indebted to the predominant Sense of Feeling for this new Explication too; and however little you may imagine it,

it, you will find that to this you have had the greatest Obligations through the whole Course of your Life.

I see very plainly, said she, that you interest yourself for the Honour of the Touch, much more than for that of *Des Cartes*; and it is not possible to propose any Difficulty, but you will be ready to give it a Solution by the Help of this Sense.

There are other Difficulties in Vision, answered I, which I will give you a Solution of without this, that you may see I have great Plenty of Explications. One of these, perhaps, may be to know what Change must be made in the Eye, in order for it to have a distinct View of Objects placed at different Distances: For, as in the *Camera Obscura*, the Rays, which flow from Objects that are near, unite at a greater Distance from the Lens, than the Rays of those which are more remote; so the very same thing happens in the Eye, where the Rays, which proceed from the Pillars of this Gallery, unite at a greater Distance from the crystalline Humour, than those that come from these Trees which are farther from it. What Change then must be made in the Eye, in order, that when we

look upon these Trees, after having looked upon the Pillars, the Rays which proceed from them may be united upon the Retina, or, in other Words, that we may have a distinct View of them.

The Retina, answered she, must be brought nearer the crystalline Humour, just as the *Camera Obscura* is brought nearer the Lens, in order to give us a distinct Image of the more remote Objects.

You have hit upon the true Explication, answered I, and some have affirmed, that certain Muscles, which encompass the Eye, are made use of to produce this Effect, and press the Retina farther back from the crystalline Humour, or bring it more forward as different Occasions require; these Muscles have besides another Office, and help us to lift up or depress the Eye, to turn it to the Right or Left, and give it a certain oblique Motion, which Venus has the principal Care of regulating.

Others have supposed, that the Retina remains immoveable, and that the crystalline Humour approaches nearer to it, and removes farther off, or that the crystalline Humour only changes it's Figure, growing more convex for near Objects, and less so for

for those which are distant ; and others have affirmed, that each of these happens at the same time, which will produce the same Effect as if the Retina approached to or receded from the crystalline Humour ; but you had better suppose this latter, because it is easiest to imagine. For every Distance then there is required a new Conformation in the Eye ; and because this cannot be effected without Motion and a certain Effort, some are of Opinion that the Eye informs us of the various Distances of Objects by a certain natural Geometry.

But this Way of judging, especially where very distant Objects are concerned, is extremely uncertain, as indeed almost all the rest are which have ever appeared upon the Stage of Philosophy.

But however this be, there are some Persons who cannot bring their Retina so near to the crystalline Humour as is necessary, in order to give them a distinct View of distant Objects. There are others, who, on the contrary, cannot press it back far enough to make Objects which are near appear distinct, the first of these, who are vulgarly called Short-sighted, are by Opticians named Myopes, and the second, com-

monly called Long-sighted, Presbytæ; these may be considered as the Extremes betwixt which that Sight, which is called just and perfect, stands.

Notwithstanding the Honour of being distinguished in Optics, by Names derived from the *Greek*, these Persons could not help perceiving they had a Defect in their Eyes, which led them to seek for some Remedy. The Myopes, in order to have a distinct View of distant Objects, and the Presbytæ of those at Hand; these last found Relief in convex Glasses, which applied to the Eye removed their Defect; for these making those Rays to become converging, which would, without their Assistance, have fell diverging upon the crystalline Humour, unite them at less Distance than they would otherwise have done: And the Image of those Objects, which are opposite to the Lens, is drawn distinctly upon the Retina. The Myopes found their Remedy in concave Glasses, which disperse the Rays and make them diverge; contrary to the convex ones, which make the diverging Rays become converging, these concave Glasses then give a Disposition to the Rays as if they came from a nearer Object than they

really

really do, and applied to the Eye of a Myop, they, in a certain Manner, transport the distant Object to a nearer Situation, and thus a distinct Image of it is drawn upon his Retina ; for there is nothing more required to give Short-sighted Persons a distinct View of any thing, than to bring it near their Eye.

It was very happy for them, replied she, to find these Glasses as safe and easy a Remedy perhaps as ever the Art of Physic itself invented. But what did they do before they were found out ?

Till the thirteenth Century, answered I, when these Glasses are supposed to have been invented, the Myopes were obliged to approach near to distant Objects, in order to see them distinctly, hoping, perhaps, that an advanced Age (when, according to the common Opinion, the Retina approaches nearer to the crystalline Humour) might give them some Relief from this Inconvenience ; but indeed this is a Remedy much worse than the Disease. The Presbytæ on the other Hand were obliged to remove a great Way off, without any Hope of ever seeing near Objects distinctly, if they should at any time have a Curiosity for it ; and they

they continually tormented their Eyes with Plaisters and Eye-Salves, without gaining the least Advantage to their Sight.

I think the Condition of these last, said the Marchioness, much more to be pitied than that of the first, both because they cannot flatter themselves with the least Hope of growing better, and because they lose a great deal more in the Conversation of the Ladies than the Myopes do. How miserable must have been the State of a poor Presbyta, who could never have a distinct View of his Mistress, unless he breathed his Sighs ten Foot distant from her !

These are not so much to be pitied, answered I, as you imagine, since this Defect generally happens in an Age, when Hope and Conversation of Ladies naturally desert us, for this is a Defect of old Men, as the very Word Presbyta imports. But there are other Defects and InfirmitieS of the Sight incident to all Ages, which are never placed in the Number of Defects, for the very same Reason, that the Folly of being more solicitous for the future than the present, and by that Means continually procrastinating our Happiness is never reckoned among

the List of Follies; namely, because 'tis common and universal. Philosophers, who are particularly sensible of the Nature of both these Defects, have discovered and sought Remedies for them; one kind of the universal Defect is, that Objects, extremely minute, are imperceptible to us, however near they may be placed to the Eye; another, that Objects excessively remote cannot be discerned, although they be of a very great Magnitude.

These are Inconveniences not at all felt by the Vulgar, but reserved for the Curiosity and nice Perception of Philosophers. The Reason of both Defects is, because the Image of very small or very distant Objects painted upon the Retina, is not big enough to be perceived by the Eye, notwithstanding any Proximity of the one, or extraordinary Magnitude of the other. The Remedies invented by Philosophers to supply them are certain Instruments, whose only Business is to magnify the Image, and render it perceptible to the Eye by Means of various Combinations of Glasses, or by one alone. Those which are made use of to discern distant Objects are called Telescopes,

and

and those which help us to a Sight of exceeding small Objects, Microscopes.

We are obliged to each of these for a Number of Discoveries, which could never have been made without them. The Heavens are the principal Object of the Telescope, from whence it has furnished Philosophers with more Curiosities than ever *Columbus* could bring from *America*, to enrich the Cabinets of *Naturalists*; for not to speak of the Hills and Vallies which they have discovered in the Moon, the Satellites of Jupiter, so very useful to Geography, those of Saturn with his Ring; it is to those Telescopes that we owe our Discovery of the Spots in the Sun, Jupiter and Mars, which are necessary in order to determine the Periods of their Revolution round themselves, and by the Assistance of these *Astronomers* have given us so exact a Map of Venus, that they are as well acquainted with her Mountains in Heaven, as the Geographers are with those on Earth.

They have discovered, that this Planet has an Increase and Decrease, that it is at one time half, at another full; in short, that it's Appearance and Phases exactly resemble those of the Moon, as it has been

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conjectured by the celebrated *Copernicus*, before the Invention of the Telescope. These give the celestial Bodies their proper Distances, and have shewn us an infinite Number of Stars unknown to the Ancients, discovering so great a Quantity in the milky Way, as is sufficient to supply ten or twelve Worlds, besides our own; in short, they have given us a true System of our World, by extending it's Confines to Infinity; so that if a Poet, to flatter a Nation, which had made a greater Progress in the Conquest of the World, than in the Knowledge of it's Frame, could say, that when *Jupiter* turned his Eyes upon our Earth, he could see nothing in it that was not subject to the *Roman Empire*; we may affirm, with greater Truth, that if he looked upon the Heavens, or, at least, the solar Vortex, he could not see any thing in it but what is the Discovery and Conquest of the Telescope.

You represent these Telescopes to me, replied the Marchioness, under such sublime Images, that I am afraid the Microscopes will make but a very different Figure when compared to them.

There is, answered I, a very remarkable Difference between them, in which, I believe,

believe, the last have the Advantage. The Telescopes, 'tis true, by discovering to us the Hills and Vallyes in the Planets, their Stations, Revolutions round their own Axis, (that is to say, their Day and Night) the Moons that from Time to Time supply the Absence of the Sun; in short, by representing them to be of the same Nature as our Earth, have furnished us with Materials to people these vast and immense Bodies which were before uninhabited, stood neglected in a Corner of the Universe, and were believed to exist for no other End than to please our Eyes; but Microscopes have made us, in Reality, see an infinite Number of Animals, of which we had not the least Knowledge before, in Things which were not looked upon as very proper to afford them a Habitation.

Not to say any thing of the Discoveries in *Anatomy* and *Natural History*, which we owe to these Glasses; aromatic Infusions, a Drop of Vinegar are peopled by so prodigious a Number of little Animals, that *Switzerland* and *China* would appear empty and uninhabited when compared to them.

The Microscope, I said she, is the Compass of Philosophy; each of these have given

given their Assistance to the Discovery of new Worlds; the only Difference is, that the Microscope has lent his Art to people, and the Compass to destroy.

It is very wonderful, continued I, into what innumerable animal Worlds Philosophers have penetrated, under the Guidance of this Compass! It is an amazing Thing to reflect upon the Minuteness, Art and Curiosity of the Joints, Bones, Muscles, Tendons and Nerves, necessary to perform the swift Motions of the smaller microscopical Animals.

These Discoveries shew us in how little a Compass all Art and Curiosity may be comprised, even in a Body less than a small Grain of Sand, and yet, as compleat, as exquisitely formed, and as finely adorned as that of the largest Animal. Their Multiplicity is no less surprising than their extreme Smallness. A Drop of the green Scum upon Water, no bigger than a Pin's Head, will contain not fewer than an hundred, which, far from being confined in that narrow Extent, play about in it with all the Freedom imaginable. The Eye of a Butterfly will contain more than twenty four Millions; and the Wonder is still greater when

when we come to consider the Organization of their fine and minute Parts. If the Eye of a Fly, which seems to be a little mis-formed Protuberance, be looked on through a Microscope, it appears to be only a Composition of Thousands of little Eyes, just as some nubilous Stars, on being viewed with a Telescope, appear to be a Cluster of innumerable other Stars. In some Insects there have been counted no less than thirty four thousand of these little Eyes, which, notwithstanding their extreme Smallness, had each of them a crystalline Humour as perfect as ours.

Why are not our Eyes, said the Marchioness, of so fine a Texture?

This Question, said I, has been already answered;

For this plain Reason, Man is not a Fly.

Say to what Use were finer Optics given,
To inspect a Mite, not comprehend the
Heaven.

But in Fact, there are some Insects, that with these Microscopic Eyes can see as far as the greatest Part of Men. The Bees, an industrious Species of Flies, from whose Labour

Labour we reap so great an Advantage, can direct themselves safely to their Hives, though at a Mile distance, when they return laden with the sweet Treasures of the Spring. It appears that what Nature has given us in Reason, she has denied us in Exquisiteness of Senses. Pigeons serve the People of the *East* for Couriers. Of this Kind (not to trouble you with so many famous in History) was that Bird, who brought to *Jerusalem*, during it's Siege, the News of speedy and powerful Succour, and took Refuge in pious *Godfrey's* Bosom: Of the same Kind also was that beautiful one, bestowed by Venus to *Anacreon*, in Return for one of his Panegyrick Odes; which, for having so often been the Messenger of his Letters to *Bathyllus*, well deserved Repose and the Honour of being sung upon that Lyre, tun'd to Gallantry and Love.

These flying Couriers, I say, being let loose by the Person who has a Mind to send home News of himself, ascend a prodigious Height, and from thence, though at a very great Distance, can see their native Country, and safely direct their Flight to it without the Help of either Stars or Compass. Whereas Moles, on the contrary,

are quite deprived of the Faculty of these sharp sighted Couriers.

Nature, said the Marchioness, has perhaps made them Amends some other Way. It is probable that she has constituted the Condition of Animals pretty near as equal as that of Man: Moles Eyes, added I, are certainly not to be envied: They are so small and covered with Hair, that it seems as if Nature had given these Tenants of Darkness Eyes to see the Light, for no other End than to fly from it. These Animals are not formed to contemplate the Wonders of the Microscope, nor see in one Drop of Water so many Thousands of Animals, organized with all that Exactness, which is necessary to enable them to see, move, and nourish both themselves and other little Animals, which repay them the Mischief they do to us, and to contain within them an infinite Number of still other little Animals, of their own Species, much less than they, and which only wait to unfold themselves to make their Appearance in the Microscope. These Observations open a Scene of innumerable other Worlds of Animals unknown before; which, notwithstanding their extreme and surprising Smallness, have their

their greater and less; their Elephants and Ants just as ours has; the only Difference is, that our Ants become Elephants when compared with their largest Animals; or rather are as the immense Distance of Saturn from us, is to the Extent of a Grain of Sand.

Indeed, said the Marchioness, this new Scene of Pigmy Worlds gives me as much Pleasure as that other immense and gigantic Scene of Vortices or Suns, scattered through the Universe.

The Little has it's Beauties as well as the Great; or rather, answered I, there is no Great or Little but with Regard to ourselves. *Gulliver*, who could destroy the *Lilliputians* like so many Fleas, was, among the *Brobdinagians*, kept in a Cage like a Canary Bird, or for an Ornament upon the Chimney, like a *Chinese* Pagod. It is principally the Microscope, and that infinite Number of Pigmy Worlds discovered by it, which has rectified our Ideas of great and little, so much, that I am persuaded that the Consideration of this incredible and surprising Smallness, which it has rendered perceptible to our Senses; has served to soften and familiarize to Mankind another Consideration, which is the Master-piece of human

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Understanding, and directly leads us to the Subversion of Great and Small. This is the Consideration of infinitely small Quantities which has made so great a Noise in the learned World, and which you perhaps may have heard of.

The Meaning of this Expression is, that there are Parts and Quantities in Extension so exceedingly small, that they may be reckoned as nothing when compared with our Measures, as the Fathom, Foot, Ounce and the like: So that if one of these Quantities was added to the Extremity of a Line (for Example of a Foot) it would not increase the Length of it, nor decrease it if it was to be taken away. And the Mathematicians affirm, that in these Quantities, infinitely small, with regard to the ordinary Measures, called Differences, there are innumerable Orders and Gradations; so that a Quantity, which is infinitely small, compared with the Order of our common Measures, is infinitely great, when compared with an inferior Order of infinitely small Quantities; and so of the rest.

The most enormous Sizes we have may become infinitely small, when compared to an Order of Greatness infinitely superior.

To

To how small a Size is reduced the Colossus of *Nero*, or that of *Rhodes*, when compared to Mount *Athos*, carved in the Shape of a Man, and holding a City in one Hand, and pouring out a River from the other, compared to *Milton's Satan*, *Virgil's Fame*; that horrible and vast Monster, the formidable Shade of *Camoens*, * that Polypheme of the Ocean, which appeared to the *Portuguese* Sailors; hid it's Head in the Clouds, and it's Feet in the unfathomable Abyss of the Sea: Or, in short, what would all this appear to that Angel, seen by *Mabomet* in his mysterious Night, whose Eyes were seventy thousand Days Journey distant from each other? It is computed that if he were of a human Shape, there must be the Distance of forty

* *Camoens*, the famous *Portuguese* Poet, in his *Lusiade*, the Subject of which is the Discovery of the *East-Indies* by his Countrymen, conducts their Fleet round the Coast of *Africa*; and as it sails in Sight of the Cape of *Good Hope*, he introduces a formidable Spectre walking in the Depth of the Sea, it's Head reaching to the Clouds, it's Arms extended over the Waves, and it's whole Form surrounded with Clouds, Storms, Winds, Thunders and Lightnings. This Spectre is the Guardian of that foreign Ocean which no Ship had ever passed through before; complains of his being obliged to submit to Fate, and the bold Undertaking of the *Portuguese*, and foretels them the Misfortunes they must undergo in the *Indies*.

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thousand Years Journey from his Head to
his Feet.

Probably, said the Marchioness, there must be a great Number of Telescopes and Speaking-Trumpets in the *Turkish* Paradise, in order for the *Mahometans* to be able to see and converse with these diabolically great Angels of theirs.

There are, answered I, the same Orders of Infinities in the Succession of Time, as there are in Extension. An Hour, a Minute, a Second, are of an infinite Duration, compared with Periods of Time infinitely shorter. How enormous must the Duration of the *Roman* Empire seem to an Animal, which in the Space of five or six Hours, is born, grows up, produces one like itself, becomes old and dies? What we should call the Flight of Time, would seem to this Insect an Eternity. But what are these Durations of Empires; this long Succession of Kings, Emperors, Consuls, and these tedious Sieges, when compared with Eternity? Is it more than a Point in which we live, fight, raise such great Commotions, and make so much Noise?

The *Orientials* say, there is a God that governs this World, who dies at the End of

of a hundred thousand Years ; and this Space another superior God esteems but as a Minute ; and yet all these Examples give us but a very imperfect Idea of Infinity. This Consideration, the utmost Stretch of the human Mind, which we owe to Sir *Isaac Newton*, and which entirely overthrows all the Ideas of absolutely great or little, was the Foundation of the famous Arithmetic of Fluxions, or infinitely small Quantities, which transplanted Geometry into a Province intirely new.

Here it made so rapid and great a Progress, that all it had done before seems nothing ; and here, by the Assistance of new Discoveries, it produced such strange Paradoxes, that they have, in some Measure, clothed Truth in the agreeable surprising Dress of Fiction : And what is the most remarkable in the new Geometry is, that by considering the Properties, Relations and Habitudes, between infinitely small Quantities, it arrives at the Discovery of common and finite Measures, which are the Object of our Enquiries.

If the Sagacity which we so much admire, said she, consists principally in uniting those Things in the Mind, and finding their Re-

lation, which seem to be in their own Nature disjointed and separated, what an unlimited Understanding must Sir *Isaac Newton* have had to find this Relation; and, in some Measure, unite these Quantities, disjoined and separated from each other, by the immense Tracts of Infinity, where the human Imagination quite loses itself?

And, continued I, the Consideration of these infinitely small Quantities, that we neither see, nor can conceive, which appeared only fit to perplex Geometry, have, in Fact, served to render it more easy, and reduced it, at the same Time, to such general Rules, that the most sublime and abstruse Truths in this Science are, at present, nothing but one of the infinite Consequences which is lost among the Crowd of those that are deduced from the Stroke of a Pen: And we now freely argue, in a Circle of Ladies, upon Truths that once required an *Archimedes*, with all that Attention of Thought which was necessary to make a Person insensible of the Noise of a Town taken by Storm, and be knocked on the Head without perceiving it.

This Consideration then of infinitely small Quantities, said the Marchioness, and the
Obser-

Observations of the Microscope, which have rendered it more familiar and common, have given a very strange Turn to Geometry. It now treats of Quantities, which, from their extreme Smallness, were once utterly unknown, and does not, at present, disdain to enter into the Company of Ladies: A Province, with which, I believe, it was once as little acquainted, as with that of the infinitely small Quantities.

It is true, continued I, that Geometry is rendered so very familiar, as sometimes to suffer itself to be treated by a Hand as beauteous as that of *Venus of Medicis*: But 'tis true likewise, that it sometimes resumes its fierce and savage Disposition, especially when it is attended by that Train of Consequences, deduced from the Stroke of a Pen, as I before mentioned to you, and goes back into Solitude and Retirement.

Mankind however, said she, ought to think themselves greatly obliged to the Microscope for having contributed to soften, and familiarize a Thing, whose very Name alone inspired so much Terror.

Mankind, answered I, are not very often guilty of the Sin of Gratitude; and as that polite Philosopher, who is to instruct you in

the Motion of the Earth, observes, there are some who make no Scruple to treat the Study of Anatomy (which perhaps may have saved their Lives) as an useless Thing. You may judge from thence, whether it be probable that Mankind will be grateful at the Expence of so much Consideration as is necessary, in order to know whether Microscopes have contributed any Thing to familiarize the Calculation of infinitely small Quantities ; what this Calculation is, and what Uses it may have ; all which Things are necessary to form a well-grounded and rational Gratitude.

An *English* Frier, called *Roger Bacon*, who lived in the thirteenth Century, and had a general Knowledge of the Effect of the Refractions of Light by a Lens, and was besides acquainted with many other Things, which are commonly believed to be the Production of much later Ages ; such as the Invention of Gunpowder ; the Reformation necessary to the Calendar, and was sensible of the false Method of Study, at that Time in Fashion : This very Man, worthy of a Statue and immortal Honours, was ill treated, persecuted, kept Prisoner for many Years, accused as a Conjuror and Wizard, and

and of holding Intelligence with the Devil, in order to effect what required only superior Parts and a free use of Reason: And all the Honour these Inventions, which we at present so greatly admire, met with, at that Time, was, that the Inventor was judged worthy to be burnt alive.

It is true, that at present, the Learned cannot enough admire the Depth of Understanding, and the quick Penetration of a Man, who, in so barbarous an Age as the thirteenth Century, thought in a Manner that very few of his Species do, even in this Age as enlightened as it is. But what Gratitude is this to persecute, imprison, and almost burn him when living; and, at the End of five Centuries, to republish and give him the highest Encomiums?

Is not this like deifying *Homer* after his Death, when he had been suffered to starve with Hunger when living?

The Telescopes which have been the Cause of so many fine Discoveries, had no less Reason, in the Beginning of the last Century, to complain of the Ingratitude of Mankind. The Spots in the Sun, the Satellites of Jupiter, and the various Appearances of Venus, were imputed to them as

so many Deceptions of the Sight, of which they alone were guilty. There was no Calumny so black that was not thrown upon them; and he, who, (I will not say invented them) but at least made so many fine Discoveries in the Heavens, by their Assistance, did not, by that Means, at all advance his Fortune here upon Earth.

It is surprising, said the Marchioness, to see the Folly and Caprice of Mankind. In some Cases they are so extremely fond of Novelty, as to adopt the most extravagant Things merely on that Account. This, we see, happens every Day in the Fashion of Dress, Sitting, taken Snuff, and even Sneezing. At another Time Novelty is an Objection to the most useful and well-contrived Schemes. Are our Judgments never to be guided by Reason?

The wise Men of past Ages, answered I, appear to us like the Moon just on the Edge of the Horizon; and those of the present Time, like the same Planet, when it is a great Way above it. The Image of the Moon, painted on our Retina when she is at the Horizon, is less than when she is elevated a great Way above it, at the Meridian (for Example) and this is occasioned

by

by the Distance of the Moon from us, which is greater in the first Case than the second. Yet, notwithstanding this, we imagine her to be much bigger at the Horizon than at the Meridian. This Mistake proceeds from the Interposition of other Objects, as Trees, Houses, Tracts of Land, Sea and Sky, which are betwixt us and the Moon, when at the Horizon, but not when she is at the Meridian; for in that Situation she is left intirely to herself. Now as the Objects, placed betwixt us and the Moon, make us imagine that she is more distant from us at the Horizon than the Meridian, they are the Reasons too why we imagine her to be bigger, because the apparent Bigness of an Object depends on the Size of it's Image on the Retina, joined to the Judgment we form of it's Distance; so that the Image being always of the same Size, the Object must appear so much the greater, as it is judged to be more distant. Hence it is that Actors, when they come from the Bottom of the Theatre, appear to us like Giants, the perspective and the Delusion of the Scene making them appear a great Way off.

Why should those Objects, placed betwixt us and the Moon, when at the Horizon, said the Marchioness, interrupting me, make us imagine her to be farther off from us, than when she is at the Meridian? I should think they would rather make her seem nearer, for in that Situation she appears to touch them, and it seems probable she should appear at the same Distance from us, as the Objects themselves; whereas, at a greater Altitude, we see her placed in the Sky, and consequently judge her to be at a great Distance.

We know, answered I, that the Moon in both Cases is in the Heavens, or rather that the Heavens themselves are an immense Vault, to which our Imagination always refers the heavenly Bodies; but the Sky itself seems much more distant from us at the Horizon, than when we look directly above our Heads, so that it appears to us as a compressed Vault. Between us and that Part of the Heavens, which is over our Heads, there is nothing to regulate our Judgment of it's Distance, whereas at the Horizon the long Series of intermediate Objects helps us to form the Distance, and make us judge it very great. Hence

it

it comes to pass, that Distances appear much greater upon a Plain than a Mountain ; because the Equality of the Plain lets us see every thing that is placed between us and the distant Object, which the Inequality of the Mountain will not suffer us to do.

This appears in the famous Picture of *Correggio* at *Parma* (*Augustine Caracchi* has greatly failed in the Plate he engraved from it, though otherwise very eminent in his Profession) where the Crowd of Figures, standing one behind another with their Heads, Hands and Feet disposed in an artful Series, make the Distance between St. *Catharine's* Hand and the *Madona's* Head appear so distinct, that you would imagine it might be measured by the Touch. This Delusion of the Eye, added to many other Graces of the Picture, makes it justly pass for a Master-piece of Skill.

Now, to finish our optic Comparison, the Ancients appear to us through a long Series of Emperors, Kings, Archons, Consuls, and many other Objects which greatly magnify them ; but we see the Moderns as it were standing alone, separated, and left entirely to themselves, like the Moon at the Meridian. Hence it is, that the Manner

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in which the Ancients buttoned their Coats, will be a Subject of Admiration to the Learned; whereas there will be only two or three Men of good Sense to applaud any useful Invention of a Modern, who has the Misfortune to be born in the same Age with ourselves, and not to be distinguished by a Name with a *Greek* Termination: And this is the Way in which a great Part of those, who value themselves upon their Learning, think. *Horace* very finely satyrized this Folly, even in the Time of *Augustus*. So true is it, that a wrong Turn of thinking is the Growth of every Age.

But would not the *Chineſe*, said the Mar-chioness, be Gainers by the immense Distance between them and us? And may not a Million of Miles produce the same Effect, as many Successions of Kings and Consuls?

They are certainly no Losers by it, answered I; but, however, those very Persons, who most idolize this Nation (which, in the Midſt of Observators and Astronomers, could not produce a tolerable Almanack) agree, that we are superior to them. This Confession perhaps is the Effect of national Self-love. The *Chineſe* form a Nation entirely separated and different from

us;

us; whereas the Ancients are as it were of the same Family with ourselves, and we regard them as our Ancestors and Superiors; and after all, some few sorry thousand Miles can never be equivalent to a List of Archons, or a Series of Consular Fasti. In short it is here, as in the Compositions of the Theatre, in which People suffer themselves to be much more easily deceived in what regards the Customs, the Modes of Thinking, and of Dress of the ancient *Greeks* and *Romans*, than in those of the *Turks* or *Japoneſe*. Another Instance, in which this Comparison holds good between the Ancients and the Moon at the Horizon is, that she appears the greater to us upon the Account of her being less resplendent there, than when she is at the Meridian. Those Objects, which are the farthest off, are the least illuminated. So that if two Objects are of an equal Size, the least illuminated will be thought the most diſtant, and consequently the biggest. Hence Trees and Housſes appear greater to Travellers in the Twilight, than in full Day, the Sun seems bigger when ſeen through a Cloud, and Objects muſt generally appear greater in *England* than they do in *Italy*.

The

The Sun, after the Death of *Julius Cæsar*, continued pale and languid for the Space of a Year, and, according to the Expression of an elegant Poet, threatned that guilty Age with an eternal Night. If the *Romans* had dealt in Observations, I do not doubt but they would have informed us, that he appeared likewise bigger than ordinary.

Objects then, said she, are magnified by the Mists of Antiquity, many of those great Philosophers, whose Names now pass for a Proverb, were perhaps no more in their own Time than the Regent of a College, or the Lector of a University.

Those, answered I, who are the most devoted to them, are the most likely to see them greatly magnified; for (as the finest and most judicious Verses in the World inform us) Fools *admire*, but Men of Sense *approve*, and every thing appears magnified to Dulness, as Objects do when seen through a Mist. I should not at all wonder, if some profound Admirer of the *Greeks* should prefer the Epicurean Explication of Vision, to that of the Moderns, for this only Reason, that one is more ancient than the other.

What

What Explication is this, said the Marchioness, for I do not remember that you have mentioned it to me before?

It was the last I spoke of, answered I, when we were talking Yesterday about the various Explications, which the Ancients have given of Sight. This supposes, that certain Shadows or Images fly off from Bodies, by whose Means we see.

Though this may seem reasonable enough to some Persons, yet there arises a great Difficulty to explain how it happens, that when we are in the Dark, we see Objects that are placed in the Light; but when we are in the Light, we cannot discern Objects placed in the Dark: Since, according to this Explication of the Epicureans in both Cases, there are Shadows which fly off from the Objects, and raise in us the Sensation of Vision.

Lucretius calls a certain lucid and subtile Air to their Assistance, which, entering into the Eyes when they are in the Dark, disengages them from the more thick and black Air that obscured them, and by this Means opens a Passage to the Shadows, which from Objects placed in the Light proceed to the Eye.

When

When Objects on the contrary are placed in the Dark, the thick black Air fills the Eyes, and by this Means denies a Passage to the Shadows, which are transmitted to the Eye from those Objects.

The Image of any Object, said the Marchioness, cannot be drawn upon the Retina, unless there are Rays transmitted from the Object to the crystalline Humour, just as in the *Camera Obscura*; an Object, in order to have it's Image painted upon the Paper, must transmit Rays to the Lens:

If then the Object be placed in the Light and we in the Dark, it's Image will be drawn upon the Retina, and we shall discern it; but if the Object be placed in the Dark, it cannot transmit any Rays to the crystalline Humour, there can be no Image drawn upon the Retina, and consequently the Object cannot appear to our Sight.

But I do not see what Relation there is between the thick or subtile Air of *Lucretius* and these Images.

It is true, answered I, that this Air has nothing to do with the Image on which Vision depends, but it has a great Relation to these Shadows on which depends the Honour of the *Lucretian Philosophy*.

And

And what is there in the World that a Philosopher, embarrassed in the Explanation of a Phænomenon, does not lay hold on? But since you have so well explained this, I will venture to propose to you another, which you must often have observed; it is, that in going from a very light Place to one which is much less so, and may even be called dark when compared with the other, the Objects in this Place are at first not at all discernable, but by Degrees they begin to appear, and after some time are seen very distinctly.

This often occasions great Mistakes in Society, which are very soon found out and repented of. Any one, for Instance, going into the Chamber of a Lady, who, either because she is indisposed, or fancies herself to be so, likes to sit in the Dark, may take one Person for another, and a fine Compliment be wrong addressed, and the Error afterwards appear to the great Confusion of the Person who had been at so great an Expence of Wit in forming it.

This Phænomenon, said the Marchioness smiling, has very great and important Consequences, and merits the utmost Attention.

But

But I must confess it appears to me a little more perplexed than the first, and I do not know how many Degrees of Subtilty in the Air *Lucretius* would require to explain it by.

Yet the Explication of this Phænomenon, answered I, depends intirely upon a thing which you must very often have observed with the utmost Diligence. Have you never remarked, that there are no Eyes, not even your own, but appear much finer by Night than in the Day?

I agree to this, said the Marchioness, that we may not spoil our Observations by Compliments; but does not it proceed from hence, that the Night does not show the Defects of the Face so much as the Day, and therefore the Eyes too must be Gainers?

The true Reason of this Phænomenon, answered I, is, that in the Dark the Pupil is more open and dilated, which makes the Eyes look blacker and brighter in the Night than in the Day, when the Pupil is more contracted.

How many Eyes have triumphed in the Evening and gained Conquests, which they lost the very next Morning at the approach of the Sun! The Pupil is contracted in very light

light Places, in order that it may not admit too great a Quantity of Rays, which would only serve to do it hurt.

On the contrary it is dilated in the Dark, enough to admit such a Quantity of Rays as are sufficient to excite Vision.

The Reason, perhaps, why some Animals never creep out of their Holes till Evening is, because they are not able to contract their Pupil so much as is necessary to hinder the Light of the Sun from injuring their Eyes.

When we go therefore from a light Place, to one which may comparatively be called dark, the Pupil, being at first very much contracted, does not admit into the Eye such a Quantity of Rays as is necessary to raise the Idea of Vision.

The Pupil afterwards begins to dilate itself, and we begin to see. And as this Dilatation is made by degrees, so we discern the Objects by degrees still clearer and clearer, till at last, when the Pupil desists from dilating itself at a certain Point, we afterwards continue to discern the Objects with the same Degree of Clearness.

You have not given me the least Time to think on this, said she; who can tell whether

ther I might not have found out this Ex-
plication, which now at least does not appear
at all difficult to me?

It is sufficient for you, Madam, said I,
to have explained one Phænomenon, and
seen the Difficulty of another.

A very great Exploit truly, said the
Marchioness with some Emotion, to see
Difficulties and not be able to resolve them.
It is a very great Honour indeed for a
General to besiege a Town and not take it.

No, said I, but it is sometimes an Honour
for him not to undertake the Siege at all.

The first Step to Wisdom is, to cease
from Folly, and the first Point of Learning,
not to be too arrogant, but perceive our
own Weakness. This you own indeed is a
Point of Modesty very little practised by
those Gentlemen, who, with the Vulgar,
gain the Reputation of Philosophers, mere-
ly by their Declaiming in Assemblies and
Coffee-Houses against the ancient Philoso-
phy, which they knew nothing of but the
Name, stigmatizing those who profess it
with the Title of *Ergotists*, and having read
perhaps some Preface or Literary Journal.

Such

Such Sort of Persons never doubt of their Knowledge, but explain and pass a decisive Judgment upon every thing.

Blind Fools! who presume to walk about a Parterre as boldly as Folks that can see, but the first Canal they come to their Foot slips and in they tumble.

There is an Observation, which the more it is examined the truer it will appear, that nothing in the World is so difficult to be met with as common Sense.

I perceive, said the Marchioness with a Smile, that I have some Right to call myself a Philosopher, for I have my Head full of Vortices; by the mere Pressure of Globules of the second Element, I can form *Light*, and *Colours* by their Rotation. I have renounced the most agreeable Qualities, and retain nothing but a little Extension and infinitely small Quantities. I am not certain whether the World appears the same to all Eyes: I explain one Phænomenon, and see the Difficulty at least of another; I think I have Contempt enough for the ancient Philosophy; and, after all this, I hope it will not be said I am not wiser than I was.

Do I want any thing else to make me a complete Philosopher?

Yes,

Yes, Madam, answered I, perhaps you should have a little less Beauty, or make a better Use of it.

But you do not perceive, that the Philosophy you are so fond of needs a Reformation, and I wish this Reformation may be the last.

What, said she with some Emotion, will you tell me that Vision is not performed in the Manner you have hitherto explained it? This is plainly betraying me and affirming, upon your Word, what afterwards appears not to be true.

No, no, Madam, answered I, be not uneasy, I am not of a Character to propose to you Things differently from what they are: Vision shall remain untouched; that Abjuration which you have generously made of the Roses and Lilies in your Cheeks, shall stand good and be ratified in Form. The Doubts you are under, concerning the different Appearance of Objects, in different Persons, shall still continue to be reasonable; and your preferring the Moderns to the Ancients shall still be compatible, and remain as 'tis founded, on the very best of Reasons. The Reformation I spoke of will affect nothing but the Globules of Light, and the

Manner in which they excite in us, the Sensation of Colours. You may hereafter, if you please, regard the System of Vortices, as one of the finest and most entertaining philosophical Poems in the World, which is the Idea under which I at first proposed it to you.

This is absolutely disconcerting my Ideas, said the Marchioness: I would willingly look upon this System as something more than a Fable, were it ever so fine a one. I can't think of changing any Thing in the Globules of Light, which, with so very little Trouble, supplied me with the most agreeable Colours: If I once quit these, who knows how much Pains, and how great an Apparatus it will cost me after this, to make even a sorry half Tintos?

It will cost you no more, answered I, than it did with your Globules. This Reformation was produced by Father *Malebranche*, one of the greatest and most illustrious *Cartesians* that ever appeared in the World. The Authority of so great a Name may let you see how very necessary this Reformation was; and you may, moreover, be sure that the Simplicity which has always formed the Delight of this Sect,

can't

can't fail here: This Simplicity is an Idol to which they sacrifice every Thing, even Truth itself; sometimes that Truth which an Ancient called, a Citizen of Heaven and a Companion of the Gods. But before I proceed to this Reformation, 'twill be proper to lay before you the great Difficulties which must make you forever renounce your Globules. This System, like *Hercules* in the Fable, had very great Difficulties to encounter with from it's very Birth; but perhaps it did not overcome them with equal Honour. Some objected, and with great Reason, that according to those Laws, assigned to the Vortices, by their Inventor himself, as the Stars are not composed of the subtile Matter, but of that of the third Element, instead of being luminous, they would be covered with an opaque Crust; and even if they were luminous, the contrary and equal Pressure of the Vortices would not suffer us to see them. However weighty these Objections might be, they would not be able to shake the Faith of the steady *Cartesians*. But this, which I am now going to mention, appears an indissoluble Gordian Knot, even to the most zealous and ardent among them: You have this

formidable Enemy of the *Cartesian* Philosophy, in your own House, nay, in the very Gallery where we are, and you don't perceive it. This painted Wall is an Adversary that makes War against the System that you are fond of.

Deliver me from this Perplexity I entreat you, said the Marchioness, or I shall erase the Picture. You have a Mind to make me quarrel with my own House for presenting me with such detestable Objects.

No, Madam, answered I, smiling, that is not my Intention: I would rather have you persuaded that every Corner of it is, since Yesterday, become philosophical. Let us fix upon one Point in the Air, to which your Eye and mine may be equally directed, while we are both looking, at the same Time, upon different Parts and different Colours of this Wall. Do you, for Instance, place yourself at this Pilaster and look upon the *Red* on the Vesture of *Achilles*: I will stand at the Window and look upon the *Blue* of the Sea; so that while you are looking at the *Red* and I at the *Blue*, our Eyes may each be directed to the same Point of Air. It is certain that two Rays will pass through this Point, one from the

Robe of *Achilles*, and the other from the Sea. These Rays, you know, are nothing but two Series or Strings of Globules, immediately touching each other ; the one continued from the Robe of *Achilles* to your Eye, the other from the Sea to mine. These two Strings of Globules intersect each other in that Point, which we have fixed in the Air, and consequently in this Point, there will be one Globule common to both Strings. Do you understand all this ?

Yes too well, said she, and I begin already to tremble.

In order for these Globules to excite Vision in us, answered I, the Pressure of those, contained in that String which comes from the Robe of *Achilles*, must be continued from thence to your Eye ; and the Pressure of those, contained in that String which comes from the Sea, must, from thence, be continued to mine. Now that Globule which happens to be in the Point of Air where the two Strings intersect, and which is common to each of them, must, at the same Time, press towards your Eye and mine ; which is utterly impossible if the Globule be hard, as *Des Cartes* supposes it to be ; because the close Union of the Parts of such

such a Body can never suffer it to press, at the same Time, towards two different Sides. But this is not all —

And yet this is sufficient, said the Marchioness, to demolish my Globules.

The very same Globule, said I, as hard as 'tis, must have, at the same Time, two different Rotations, one to excite in you the Idea of a red Colour, which is communicated to the whole String that comes from the Robe of *Achilles* to your Eye; and the other to excite in me the Idea of an azure Colour, communicated to the whole String that comes from the Sea to my Eye. But the Difficulty will be still greater if we suppose other Spectators to be placed in this Gallery, who all direct their Eyes to the same Point in the Air as we have fixed upon, and other Rays to pass through this Point, some of which should convey the Golden Colour of *Achilles*'s Hair, that *Minerva* lays hold on in order to calm his destructive and impetuous Rage; others the Green of this Meadow, and the innumerable other Colours which variegate the Picture. You see then, that supposing your Globules such as *Des Cartes* has made them,

it would be impossible for us to see what we
really do see.

I understand this but too well, answered
she ; but I beseech you, for the Love of
Philosophy, never mention these Globules
to me again. I am resolved to think no
more of them, since they have so shame-
fully yielded to the very first Difficulty :
They seem to resemble those unexperienced
Lovers, who, at their first Repulse, think
of a Retreat. But pray let me see what
your reformed *Cartesian*, *Malebranche*, sub-
stitutes in their Place ; for I am persuaded
he will be able to make a better Resistance.

Malebranche, answered I, entirely rejects
these solid Globules, which you have for-
bid me to mention, and substitutes in their
Place, certain exceeding small and fluid
Vortices, composed of an ethereal and very
subtile Matter, which fills all the great Vor-
tices, as the great Vortices which are the
Seats of Stars and Light do the Universe.
These little Vortices, by that Power which
they have of dilating themselves, keep a
mutual Equilibrium in their respective Vor-
tices, just as the great Vortices do in the
Universe. In this System of *Malebranche*,
Light is nothing but the Undulation or Vi-
bration

bration of the Vortices, occasioned by the Vibration of the luminous Body, which is always repelled in the same Moment that it impels, and the greater or less Force of the Light depends upon the greater or less Force of these Vibrations, just as Colour depends on their greater or less Velocity. For Instance, if these Vortices should raise fifty Vibrations upon the optic Nerve or the Retina, in any determinate Space of Time, it would excite in us the Idea of a certain Colour; if in the same Time there should be a greater or less Number of Vibrations raised, we should have the Sensation of a different Colour. *Malebranche* ingenuously confesses however, that he was not able to assign what determinate Degrees of Quickness were necessary to form different Colours in particular. A Confession so much the more ingenuous as 'tis extraordinary in a Philosopher.

This System of *Light* and *Colours* has a very great Affinity with that of Sound, with this Difference only, that Air is the Vehicle or Channel of the one, and the ethereal Matter of the minute Vortices, composed of that Matter, the Channel of the other. The Vibrations which a sonorous Body, when 'tis

struck, raises in the Air, and from thence, in the auditory Nerve, excite in us the Idea of Sound. In the same Manner, the Vibrations which a luminous Body raises in the ethereal Matter, and from thence in the optic Nerve, excite in us the Idea of Light; so that if the Air be entirely excluded from any Place (which may be done by the Help of a certain Machine called an Air Pump) a sonorous Body put into that Place would not be heard to sound. In the same Manner, if it were possible to exclude the ethereal Matter from any Place a luminous Body put into that Place, would not appear resplendent. The greater or less Force of the Vibrations on the Air, or the auditory Nerve, produces a greater or less Intenseness of Sound. In the same Manner, the greater or less Force of the Vibrations in the ethereal Matter, or in the optic Nerve, produces a greater or less Intenseness of Light. The different Velocity of the Vibrations on the Air, or the auditory Nerve, produces the Difference of Tone, such as Bass, Treble, and their several Degrees: So after the same Manner the different Velocity of Vibration, raised in the ethereal Matter, or the optic Nerve, produce different

ent Colours, as *Red*, *Yellow*, and the like, which may be considered as Tones of Light.

I don't believe, said the Marchioness, that even our Preachers ever carried a Similitude farther than this.

It may be carried still farther, answered I. As various and different Vibrations cross and intersect without destroying, or rather without giving each other the least Interruption, which we every Day see in Concerts of Music, where the Vibrations of the Strings of a Violin don't interrupt those of any other Instrument; so the different Vibrations which flow to our Eye from different Colours, don't interrupt each other notwithstanding they touch and intersect. The Fluidity of these Vortices gives them a Power of transmitting their Vibrations, of different Colours, to various Parts, which the Solidity of the Globules would not suffer them to do, in the same Manner as the Fluidity of the Air does the different Sounds in a Concert of Music. The Exposition of this seems so very difficult to *Malebranche*, that he affirmed, a System capable of effecting it must be conformable to Truth.

Sound and Light, replied the Marchioness, appear to be as faithfully copied from each other, as Nature was by the Paintings of *Apelles*, which were so very accurately done, that an Astrologer could predict the future Fortune of the Persons whom they represented.

I have not yet finished the Comparison, answered I. An Object placed between two Looking-Glasses, over-against each other, will be greatly multiplied.

One Candle is changed into a thousand, and brings to Mind the celebrated annual Feast of the Illumination of Candles among the *Egyptians*; from which, some imagine the *Chinese* to have borrowed the Feast of Lanthorns. And does not the famous Echo of the Castle of *la Simonetta*, not far from *Milan*, produce the very same Effect upon Sound? The Report of a Pistol in this Place is repeated more than forty Times; and a single Instrument of Music forms a Fulness of Sound superior to that of the most numerous Concert. Two great Wings of a Building, opposite to each other, with Windows, which are all false except one, and formed with a Matter very proper to throw back the Vibrations, reflect and multiply

tiply the Sound just as the two Glasses do the Candle. The great Lord *Bacon*, the Harbinger of true Philosophy, has, among innumerable other curious Things, proposed the Examination of this Affinity, betwixt Light and Sound, to the Consideration of Naturalists. Perhaps he could not have wished to find a more close Union betwixt them, than what the System of *Male-branche* discovers: But he advised too that Philosophers should carefully examine in what Points they might disagree; and the greatest Difference betwixt them is, (as I first told you) that the Channel of Sound is the Air, and that of Light the ethereal Matter. Hence it follows, that Sound must be propagated from a sonorous Body in Time; for the Spaces and Interstices between the Particles of Air, make it absolutely necessary that there should be some little Time before the Motion can be communicated from one Particle to another. Light, on the contrary, must be propagated in an Instant, or an exceeding little Space of Time, because there are no Spaces betwixt the Vortices or ethereal Matter, since the whole Universe is every where filled with them. Light and Sound have the same

Resemblance

Resemblance to each other as, the Nereids engraved by Vulcan upon the Silver Gates of the Sun's Palace, in *Ovid's Metamorphoses*. Their Features are not exactly the same, but so extremely like, that 'tis very easy to perceive they are Sisters.

Tho' various Features did the Sisters grace
A Sister's Likeness was in every Face.

Let us then become reformed *Cartesians*, said the Marchioness, by accepting a Reformation, which not only explains all that the Globules did, but something more, and of much greater Importance, which they were not able to explain. Let us adopt *Malebranche's* System of Light and Sound, these two new Brothers in Natural Philosophy.

I do not absolutely despair, answered I, but the Harpsicord of Colours and the Music of the Eyes, which gives still a greater Confirmation to this new Alliance, may, in Time, meet with a favourable Reception from you.

What do you mean, replied the Marchioness, by this new invented Music and Harpsicord? Have you a Mind to ridicule the

the philosophical Similitude you have been entertaining me with?

I should be very sorry, answered I, to have any Temptation to ridicule what you have [adopted instead of your Globules.

This Harpsicord is, indeed, a new Invention, but is not, therefore the less true or real. Upon moving the Keys of this Instrument, instead of hearing Sounds you will see Colours and half Tintos appear, which will produce the same Harmony as Sounds do. The Sonatas of *Rameaux* or *Corelli*, will give you the same Pleasure to the Eyes, when seen upon this philosophical Harpsicord, as they do to the Ear, when they are played upon the common Sort. The Concords of a Piece of Purple and Scarlet will raise the Passions of Love, Pity, Courage or Anger in our Souls: This surprising Instrument is now making beyond the Mountains, and you may, for the future, expect your Silks and Ribbons in Music. The transient Pleasures of the Ear will be fixed in the Eye; you may continually enjoy the fine Airs of *Farinelli* wove in a Piece of Tapestry.

The Inventor, answered she, probably took the first Idea of this from the Dress
of

of a Harlequin. However we are greatly obliged to him, for we shall have no Occasion to embarrass ourselves for the future in adjusting the Colours of our Clothes. We need only consult the Thirds and Octaves of this Harpsicord, and we shall be sure never to make any Discord in the Shading.

The Painters, answered I, may find Relief in their Indispositions from this new invented Music of Colours, as Singers and Musicians are said to do from that of Sounds.

Why will you restrain the Effects of so singular a Thing, said she, to the Painters only? It will help Physicians to increase their Prescriptions and prolong their Consultations.

Physicians, answered I, must act with regard to their Patients, as Musicians do with weak Voices; and as those are careful not to discourage their Scholars with difficult Notes, so these in certain Distempers, as the Bite of a *Tarantula*, which can be cured only by Pleasure, must take Care not to prescribe any Colours for which the Patient has an Aversion. But we must leave the Physicians to divert their Patients in this new Method as they judge proper. This new

Instrument

Instrument will help to give us a Proof of the Justness of that fine Comparison made by an elegant Poet between the gradual languishing and dying Sounds in the Voice of our tuneful *Orpheus*, and the insensible Fading and Vanishing of the Colours in the Rainbow.

Who knows, replied the Marchioness, but we may some time or other form a Dinner by the Assistance of a Harpsicord, and find Harmony in a Fricassie?

After this Discourse, as we were taking the Air in the Garden, the Marchioness suddenly cried out,—What shall we do? I see a neighbouring Gentleman coming towards us, who, in every Visit he makes, does me the Favour to repeat Sonnets by the Hundred, and yet always finds Time for some Ode. How shall we disengage ourselves from his troublesom Company? Will there be no Vortex so merciful as to snatch him away with itself, and remove him from our System?

For want of a Vortex, answered I, we will serve him as I once did a Mathematician, who happens to be very talkative, a Fault which those Sort of People are seldom guilty of. When you are walking with

with a Friend, and discoursing about the Country of *Kouli Kan*, or some such Trifle, he will entertain you with the most abstruse Points in Geometry. He assaulted me one Day as I was walking with some Company in a Garden, and we presently found by his Air that he was preparing to torment us with his Demonstrations and Corollaries. I and the others which were with me began to talk of Poetry, and repeat Verses (a Language to which he was an utter Stranger) without suffering him once to open his Mouth. By this Means we compassed one of the most difficult Enterprizes, that of tiring the most tiresom Person in the World. Now we need only continue our Discourse upon Philosophy, and I will engage your Sonnetteer will suffer the same Punishment as my Mathematician. Thus we agreed, and thus acted. After the first Compliments were over, the Poet, who knew nothing of our Scheme, took occasion to inform us, that the Muses had for a long Time used him ill, and that he was resolyed to renounce them for ever.

After we had civilly contradicted him, he answered, that he was ready to prove his Assertion by a few Sonnets which he had

had lately made, and which would shew us how very little he was in their Favour.

If they are really so perverse, said the Marchioness, taking him at his Word, you must intirely abandon, and never think of them again. We have just been discoursing on Philosophy and Optics, 'twill be taking an effectual Revenge if you enter into our Conversation, which is so very different from Poetry. He excused himself by saying, that he had not a Capacity for such sublime Subjects, and though it was necessary sometimes to shew a little Resentment, he must take Care not to affront the Muses too much. He observed that a little Poetry would alleviate the Severity of our philosophical Discourses, and alledged the Example and Authority of *Plato*, who did not think it beneath him to write Love Verses to *Agatis*, and engrave the three Graces on the Citadel at *Athens*, with the same Hand with which he had wrote the Institutions of his Republic and the *Timeus*, and in this Manner divided his Time between Philosophy and the Arts of *Apollo*. But all these Arguments could not prevail on us to let him repeat his Sonnets, which was the chief

Design

Design both of his Visits and all that Eru-
dition which he had lavished upon us.

The Marchioness asked me several Que-
stions, which our Poet did not think at all
a propos. Among the rest, she was very
anxious to know whether she might rely
on *Malebranche's* System of *Light* and *Co-
lours*; for the Fate of the Globules made
her fear every Thing, and her Suspicions
were terribly increased by this new Harp-
sicord.

I answered, that such was the Condition
of all human Things, that nothing must
hope for a long Duration here below, a
Truth which our Gentleman could evince
by many fine Verses of the best Poets, and
perhaps by some of his own. I added, that
I was extremely pleased to find the Ex-
ample of the Globules had warned her not
to place too much Confidence in the Re-
formation of Father *Malebranche*; but that
the most fatal Blow to this Opinion was,
the being obliged to forsake it upon the
Account of that very Analogy and Cor-
respondence betwixt Light and Sound, which
at first seemed to give it so much Lustre.

This Analogy, continued I, fails in one
of the Parts, and in that Part where it was

most wanted. And this Circumstance is sufficient to overthrow *Malebranche's* reformed System. All those fine Resemblances, which you observed with so much Admiration, can't save it from Destruction. If an undulating Motion happens to meet with any Obstacle in it's Way, this does not stop it's Progress, for it bends on all Sides, and continues to propagate itself in Spite of the Obstacle that opposes it. A very familiar Example will make you understand what I mean. If we were at the Bottom of this Hill, and some Person on the opposite Side of it should sound a *French-Horn* to proclaim the Destruction of some innocent Tenant of the Woods, whose only Fault is the Pleasure we find in destroying him by the Help of our Reason and Contrivance, we should hear this Sound, notwithstanding the whole Hill is placed betwixt the Horn and our Ear. The Reason of this is, because the Undulations, raised in the Air by the *French-Horn*, don't stop their Progress when they meet with the Hill, but giving way on every Side, and bending all round it, communicate the like Vibrations to the opposite Air. After the same Manner, if you throw a little Stone into this Basin, the Undula-

tions formed in the Water will not stop when they meet with the Pipe, but giving way all round it, will communicate themselves indifferently to all the Water, and thus the Effects of it will be discovered in the whole Bason.

You see then, that if Light were nothing but an Undulation of the ethereal Matter communicated to it by the Vibrations of the lucid Body, no interposed Body could ever deprive us of the Light of the Sun, or any other luminous Object; or, in other Words, we should never have any Shadow, which (especially in this Season) would be a terrible Inconvenience brought upon us by *Malebranche's* System. The Pressure of *Des Cartes* Globules could give us no Assistance in this Case.

Thus Sir *Isaac Newton*, the avowed Enemy to imaginary Systems, and to whom you are indebted for the true Idea of Philosophy, has at one Blow lopped off the two principal Heads of the reviving *Cartesian* Hydra.

Though the Marchioness perceived the Force of this Argument, she did not seem greatly displeased with it. As she had renounced the Globules, she easily gave up the

Vortices;

Vortices; but our Sonnetteer was not quite so well satisfied. As he could find no Opportunity of discharging his poetic Fury, he was obliged to go some where else to find an Audience to a Satire, which it is very probable he had begun to compose against Philosophy.

The End of the FIRST VOLUME.





